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Cleveland Academy of Natural Sciences.

CONDUCTED BY

HAMILTON L. SMITH, A. M.

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PROSPECTUS.

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HAMILTON L. SMITH, Cleveland, O.

List of American and Foreign Periodicals referred to in the Annals of Science.

ENGLISH.

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London Journal of Science,
" *Mechanics' Magazine,*
" *Philosophical Magazine,*
" *Practical Mechanics' Journal,*
Practical Mechanics' Magazine, Glasgow,
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Annales de Chimie et de Physique,
Bulletin de la Soc. Geologique de France,
Comptes Rendus des Seances de l'Academie des Sciences.

AMERICAN.

Silliman's American Journal of Science,
Western Horticulturist,
Journal of the Franklin Institute,
Gould's Astronomical Journal.

GERMAN.

Poggendorf's Annalen,
Haller's Archives,
Schmidt's Jahrbucher,
Liebig's Annalen der Chemie und Pharmacie,
Astronomische Nachrichten.

THE ANNALS OF SCIENCE.

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DRIFT ETCHINGS—LAKE SUPERIOR.

BY CHAS. WHITTLESEY.

[Communicated for this Journal.]

It is only recently, that the drift phenomena have begun to be investigated in America. All over the northern part of the United States, where geological surveys have been made, the rocks are found to be worn smooth, abraded, polished, scratched, and grooved. The same thing had been observed before, and studied in the north of Europe; and the fact was so interesting, so striking, and so universal, that the philosophers of the Old World set about investigating the *cause*, or force, to which these scratchings and groovings are due.

The most splendid, and for a time the most satisfactory theory, was that of Agassiz, which is called the "Glacial Theory." He formed it, after examining the glaciers of the Alps, during several summers, in company with Mr. Desor, of Neufchatel. The immense fields of ice that rest upon the mountain range, between Switzerland and Italy, have a continual but very slow motion, down the gorges and valleys of the mountains. In their progress, which is sometimes not more than 280 feet in a year, they produce the same powerful effects upon the rocks beneath, and at the sides of those valleys, which are observed on the rocks of Northern Europe and America.

Agassiz therefore supposed the diluvial grooves to be due to the same cause.

To apply the glacial theory to so great an extent of country as a hemisphere, or a large portion of one, required a period of unusual ice. An age, or era of ice, was a supposition not very extravagant; but in the level countries south of the Baltic, in Europe, and those south and west of the great lakes, in the United States, how were glaciers to acquire their motion?

The olden theory of powerful currents of water, enveloping the northern half of the globe, and rushing to the southward, fell, under the investigations of Agassiz.

It became evident that ice had some agency in producing the scratches; but after much reflection and examination, the American geologists doubted of the universal existence of *such* masses of ice as compose glaciers.

Mr. Desor, and other European geologists, who had observed the abrasion of rocks, and the striæ on their surface, in Scandinavia, also doubted whether glaciers could have existed, and moved over such vast spaces, particularly in low, or even, and not mountainous regions.

The marks, scratches and striæ that we behold, are those of fixed and hard points in a solid body, moving with irresistible force over an immovable rock. They are in straight lines, generally north and south, or nearly in the meridian, and the movement was evidently *from* the north.

The "aqueo-glacial" theory has sprung up out of the other two, which admits the agency of both *ice and water*.

The ice is supposed to be in large floating masses, carried forward slowly, by currents of water, at a period when the present mountain chains were entirely under the surface of the sea. Such things are now witnessed, in the Arctic seas. Fields of ice embracing forty and fifty thousand square miles, of great thickness, move uniformly in one direction, for a great length of time. The grounding, rubbing, and abrasion of such masses, upon the rocky bottom of the sea, or the most elevated points of its bed, would resemble what is seen on the rocky uplands of both continents.

If in these masses there were fixed blocks and fragments of rocks, with hard angles and points, those points would produce the furrows, grooves and scratches, that we observe.

On all such questions, the first duty of the geologist is to collect his facts, and defer the speculation, till it can be discussed on a basis of thorough observation.

During the government explorations of the mineral beds on the south shore of Lake Superior, this subject occupied the attention of the gentlemen engaged, particularly Mr. Desor. On the rocks of both shores, and on the shores of Lakes Michigan and Huron, are the same planished surfaces, which are seen beneath the glaciers of the Alps.

There are large areas of many miles together, where the trap and other igneous, as well as sedimentary rocks are worn as smooth as an old hearth-stone. There are also, as may be seen,

(given on following p.,) cases where the perpendicular faces or walls of rock, especially in narrow gorges, are marked and striated, exactly like the rock floors just spoken of. The scratches that are seen on the sides of ravines are generally horizontal, as though they were made by a mass of hard and solid materials, driven at a steady and uniform rate, through the breaks in the ranges.

My intention, however, at this time, was merely to collect and compare the recorded observations, heretofore made in this region, adding a few of my own.

This being the most northerly part of the United States, where they have been studied, renders such a collection particularly reliable.

The bearing of the grooved lines is counted southward, each way from the meridian, that being the direction towards which the drift forces acted.

These instances, although not very numerous, cover a large extent of the Lake country. That by Dr. Norwood is on the north shore, near the west end of the Lake. Those on Isle Royal are 160 miles north-east, measuring along the same shore; and those on Point Keweenaw, and the Ontonagon, embrace 80 miles of the south shore, opposite. The next parcel are taken from a tract 60 miles south of Point Kewenaw, and 160 miles west of the Saut Ste. Marie. Every one who examines the list will be struck with the *uniformity in the bearing* of these drift furrows, showing a remarkable parallelism over a large space.

They are all north-easterly and south-westerly, except the case at the Ohio mine, which is in a gorge of the mountain, and no doubt controlled by the form of the ground.

One-half of the cases given are between S. 20° and S. 30° west. This is conclusive as to the prevalence of a wide-spread force acting every where in the same direction.

The same general direction prevails over a still larger space, to the south and west. Mr. Desor and myself had an opportunity of noticing them on the Menominee river, in the interior, sixty miles south-west of the Carp river iron region.

The results are given in Part II of the Report of Messrs. Foster and Whitney, page 244:—

Irwin Falls	S. 60° to 70° W.
Bekuenesoe Falls	S. 70° W.
Sturgeon Falls	S. 65° W.

The direction is here south-westerly, and farther south, westward. At Sheboygan, in Wisconsin, where the lime rocks are worn, over many square miles, into smooth surfaces like marble, the grooves and troughs are also S. W. and S. S. W.

Far to the north-west of Lake Superior, at Rainy Lake, I observed in 1848, that many of the low rocky islets in which the lake abounds, were worn into those peculiar *domes* which the French call "*moutonnès.*"

On these islands, composed of talc slate, mica slate, and granite, the scratches were not always distinct, but the polished surfaces were.

The scratches or striæ were distinct on the harder rocks, and bore from S. W. by S. to W. S. W., corresponding with those of Lake Superior, and the country south of it.

An instance is given by Mr. Desor, (page 207, Foster and Whitney's Report, Part I,) of diluvial striæ on a *vertical wall*, near Teal Lake of Carp River. Those which I examined, at the Ohio and at the Adventure mines, showed the same evidence of force and pressure against the wall, as the cases of flat or horizontal surfaces adjacent. At the Adventure they were uncovered, in running an adit through the red clay drift, to the rock. It presented, at the end of the adit, a smooth, upright, polished wall, all the minor irregularities worn away, and a plane, or moderately warped surface, remaining. The lines were as fresh as the fracture of the rock in the adit, showing that they had never before been exposed to the atmosphere. A slip of the clay over head exposed many feet of this planished face, which extended to an unknown depth below.

The grinding action which could wear away tough and jagged trap rocks like these, must have been of intense power, and of long duration. At the Ohio and Aztec locations, the mural striæ were in one case rising to the north, and pitching to the southward, and not level, as at the Adventure and Teal Lake localities.

Both at the Aztec and the Adventure, the vertical faces were partly over the edge of the ridge to the southward,—at the former, at least 150 feet below the crest of the range, but the descent was through a gap oblique to the range.

The scouring process, acting more rapidly on the softer parts of rocks, has made channels along the backs of veins in some instances, and thus serves to disclose the existence of metallic lodes which are usually concealed from surface observations.

The long, ditch-like depressions indicative of copper veins, which the eye of a practical explorer readily detects, are due in many cases more to the abrading action of the drift than to decomposition.

Thus, that mysterious agency which pulverized the rocks and changed them into soil, by trituration and mixing their particles, subserved the interests of man in another way, by pointing out to him the position of mineral deposits.

Direction of the Diluvial Scratches, Furrows and Troughs, on and near Lake Superior.

GEOGRAPHICAL POSITION.	BEARING.	ELEVAT'N ABOVE L. SUPERIOR.	KIND OF ROCK.	OBSERVERS.	REMARKS.
Isle Royal.		Feet.			Rocks worn into troughs, hollows & domes.
Scovill's Point, ...	s. 50° w.	00	Amygdaloid Trap.	Desor.	Well polished on all the surfaces.
Chippeway Harbor..	s. 50° w.	00	Amygdaloid Trap.	Desor.	Striæ furrows, and powerful excavations.
Shores of Isle Royal.	s. 20° w.	00	Conglomerate & Trap	Desor.	
—					
Passabiska River near Fond du Lac,.....	s. 46° w.	00	Basaltic Trap.	Norwood.	Very much worn and polished.—*Owen's Report*, p. 348.
—					
Kewenaw Point.					
Near Cliff Mine.....	s. 15° w.	550	Greenstone Trap.	Foster & Whitney	Rock very hard, columnar, well polished.
Near Meadow Mine..	s. 40° w.	500	Amygdaloid Trap.	Nobis.	Very smooth, but striæ not deep.
Near Phœnix Mine..	s. 20 to 25° w.	350	Amygdaloid Trap.	Nobis.	" " " " " "
Near Cop. Falls Mine	s. 65° w.	300	Conglomerate.	Nobis.	Rock perfectly polished, pebbles worn smooth and scratched—north'n slope of range, furrows distinct and parallel.
" " " "	s. 5° w.	600	Amygdaloid Trap.	S. W. Hill.	Distinct, near the summit of the range.
Ontonagon District.					
Near Aztec Mine ...	s. 27 to 36° w.	650	Amygdaloid Trap.	Nobis.	Rock well smoothed, summit of the range.
Near Ohio Mine	s. 30° E.	500	Amygdaloid Trap.	Nobis.	" " " in a gorge. The sides of the gorge polished, and domes, or 'roche moutonnès,' polished on all sides.
Near Adventure Mine		450	Amygdaloid Trap.	Nobis.	Broad gorge, west wall perpendicular, worn smooth, lines distinct and fresh—level, covered by red clay—warped surfaces.
Chocolate River Dist.					
Riviere des Morts ...	s. 20° w.	00	Hornblende Rock.	Foster.	Trough-like depressions—same course.
" " " ...	N. & S.	00	Hornblende Rock.	Foster.	Secondary system.
Middle Island	s. 20° w.	00	Granite	Foster.	Broad troughs, with the same bearing.
Marquette Landing..	s. 55° w.	00	Hornblende & Chlorite	Desor.	Rocky points & islets smooth on north side.
Near Carp River....	s. 20° w.	500	Quartz.	Whitney.	1st quartz ridge, well polish'd & glistening.
" " "	s. 25 to 30° w.	531	Quartz.	Desor.	2d " " " " "
South of Teal Lake..	s. 55° w.	750	Magnetic Iron.	Desor.	Perfectly smooth.
Jackson Forge......	s. 65° w.	1000	Magnetic Iron.	Desor.	" "

TWENTY-THIRD MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AT HULL, SEPT. 7.

THE PRESIDENT'S ADDRESS.

[Concluded from page 38.]

Some of the most interesting of recent discoveries in organic remains are those which prove the existence of reptilian life during the deposition of some of our oldest fossiliferous strata. An almost perfect skeleton of a reptile belonging to the Batrachians or Lacertians was lately found in the Old Red Sandstone of Morayshire. The remains of a reptile were also discovered last year by Sir Charles Lyell and Mr. Dawson in the coal measures of Nova Scotia; and a batrachoid fossil has also been recognized in British coal shale. But the most curious evidence of the early existence of animals above the lower orders of organization on the face of our globe, is that afforded by the footprints discovered a short time ago in Canada by Mr. Logan on large slabs of the oldest fossiliferous rocks,—those of the Silurian epoch. It was inferred from the more imperfect specimens first brought over, that these footmarks were the marks of some reptile; but more perfect examples, afterwards supplied by Mr. Logan, satisfied Prof. Owen that they were the impressions of some animal belonging to the Articulata, probably a crustacean. Thus the existence of animals of the reptile type of organization during the Carboniferous and Devonian periods is clealy established; but no evidence has yet been obtained of the existence of those animals during the Silurian period. After the discoveries which I have mentioned, however, few geologists will perhaps be surprised should we hereafter find that higher forms of animal life were introduced upon the earth during this early period than havo yet been detected in its sedimentary beds.

Many of you will be aware that there are two theories in geology, which may be styled the theories of *progression* and of *non-progression* respectively. The former asserts that the matter which constitutes the earth has passed through continuous and progressive changes from the earliest state in which it existed to its actual condition at the present time. The earliest state here contemplated may have been a fluid, or even a gaseous state, due to the enormous primitive heat of the mass, and it is to the gradual loss of that heat the progressive change recognized by this theory is chiefly attributed. The theory of *non-progression*, on the contrary, recognizes no primitive state of our planet differing essentially from its existing state. The only changes which it does recognize being those which are strictly periodical, and therefore produce no permanent alteration in the state of our globe. With reference to organic remains, the difference between these theories is exactly analogous to that now stated with reference to inorganic matter. The theory of *progression* asserts that there has been a general advance in the forms of organic life from the earliest to the more recent geological periods. This advance must not be confounded, it should be observed, with that progressive development according to which animals of a higher organic structure are but the improved lineal descendants of those of the lowest grade, thus abolishing all distinction of species. It is merely meant to assert that the higher types of organic being are far more generally diffused at the present time, and far more numerous and varied than they were at the earlier geological periods; and that, moreover, at the earliest of those periods which the geologist has been able to recognize, some of these higher types had probably no existence at all.

Each successive discovery, like those which I have mentioned, of the remains of animals of the higher types in the older rocks, is regarded by some geologists as an addition to the cumulative evidence by which they conceive that the theory of *non-progression* will be ultimately established; while others consider the deficiency in the evidence required to establish that theory as far too great to admit the probability of its being supplied by future discovery. Nor can the theory derive present support, it is contended, by an appeal to any properties of inorganic matter, or physical laws with which we are acquainted. Prof. W. Thomson has recently entered into some very interesting speculations bearing on this subject, and suggested by the new theory of heat of which I have spoken. The heat of a heavenly body placed under the same conditions as the sun, must, it has been said, be ultimately exhausted by its rapid emission. This assertion assumes the matter composing the sun to have certain properties like those of terrestrial matter with respect to the generation and emission of heat; but Professor Thomson's argument places the subject on better grounds, admitting, always, the truth of the new theory of heat. That theory asserts, in sense which I have already stated, the exact equivalence of heat and motive power; and that a body, in sending forth heat, must lose a portion of that internal motion of its constituent particles on which its thermal state depends. Now we know that no mutual action of these constituent particles can continue to generate motion, which might compensate for the loss of it, thus sustained. This is a simple deduction from dynamical laws and principles, independent of any property of terrestrial matter which may

possibly distinguish it from that of the sun. Hence, then, it is on these dynamical principles that we may rest the assertion that the sun cannot continue for an indefinite time to emit the same quantity of heat as at present, unless his thermal energy be renovated from some extraneous source. The same conclusion may be applied to all other bodies which, like our sun, may be centers of intense heat; and hence, recognizing no adequate external supplies of heat to renovate these existing centers of heat, Prof. Thomson concludes that the dispersion of heat, and consequently of physical energy, from the sun and stars into surrounding space without any recognizable means of reconcentration, is the existing order of nature. In such case the heat of the sun must ultimately be diminished, and the physical condition of the earth, therefore, altered, in a degree altogether inconsistent with the theory of non-progression.

Mr. Rankine, however, has ingeniously suggested an hypothesis according to which the reconcentration of heat is conceivable. Assuming the physical universe to be of finite extent and surrounded by an absolute *vacuum* radiant heat (supposing it to be propagated in the same way as light) would be incapable of passing into the *vacuum*, and would be reflected back to foci corresponding to the points from which it emanated. A reconcentration of heat would thus be effected; and any of the heavenly-bodies which had previously lost their heat, might, on passing these foci, be rekindled into bright centers of radiant heat. I have alluded more particularly to this very ingenious, though, perhaps fanciful hypothesis, because some persons have, I believe, regarded this view of the subject as affording a sanction to the theory of non-progression; but even if we should admit its truth to the fullest extent, it may be deemed, I think, entirely inconsistent with that uniformity and permanence of physical condition in any of the heavenly bodies which the theory just mentioned requires in our own planet. The author of this hypothesis did not possibly contemplate any such application of it; nor am I aware how far he would advocate it as really applicable to the actual constitution of the material universe, or would regard it as suggesting a possible and conceivable, rather than a probable mode of counteracting the constant dispersion of heat from its existing centers. He has not, I think, attempted to work out the consequences of the hypothesis as applied to *light*,—to which it must, I conceive, be necessarily considered applicable if it be so to heat. In such case the foci of the reflected heat would be coincident with those of the reflected light, proceeding originally from the same luminous bodies. These foci would thus become visible as the images of the stars; so that the apparent number of stars would be constantly increasing with the increasing number of images of each star produced by successive reflexions. This will scarcely be considered the actual order of nature. It would be easy to trace other consequences of the application of this hypothesis to light; but I would at present merely state that my own convictions entirely coincide with those of Prof. Thomson. If we are to found our theories upon our knowledge, and not upon our ignorance of physical causes and phenomena, I can only recognize in the existing state of things a passing phase of the material universe. It may be calculated in all, and is demonstrably so in some respects, to endure under the action of known causes, for an inconceivable period of time; but it has not, I think, received the impress of eternal duration in characters which man is able to decipher. The external temperature and physical conditions of our own globe may not, and probably cannot, have changed in any considerable degree since the first introduction of organic beings on its surface; but I can still only recognize in its physical state during all geological periods, a state of actual though of exceedingly slow progression, from an antecedent to some ultimate state, on the nature of which our limited powers will not enable us to offer any conjecture founded on physical research. The theories, even, of which I have been speaking, may probably appear to some persons as not devoid of presumption; but for many men they will ever be fraught with deep speculative interest; and, let me add, no charge of presumption can justly lie against them if entered upon with that caution and modesty which ought to guide our inquiries in these remote regions of physical science.

I feel how imperfect a view I have now submitted to you of recent scientific proceedings. I have given no account of the progress of Chemistry, of Practical Mechanics, or of the sciences connected with Natural History; nor have I spoken of Ethnology, a science which, though of such recent date, is become of great interest, and one which is occupying the minds of men of great learning and profound research. I can only hope that the chair which I have now the honor to occupy, will be henceforth filled by men qualified to do full justice to these important branches of science. I trust that what I have said, however, will convey to you some idea of the activity which pervades almost every department of science.

I must not conclude this Address without some mention of what appear to me to be the legitimate objects of our Association—nor without some allusion to circumstances calculated, I think, to give increased importance to its general working and influence.

There are probably few amongst us of whom

the inquiry has not been made—after any one of our meetings—whether any striking discovery had been brought forward?—and most of us will also probably have remarked that an answer in the negative has frequently produced something like a feeling of disappointment in the inquirer. But such a feeling can arise only from a misapprehension of what I conceive to be the real and legitimate objects of the British Association. Great discoveries do not require associations to proclaim them to the world. They proclaim themselves. We do not meet to receive their announcement, or to make a display of our scientific labors in the eyes of the world, or to compliment each other on the success that we have met with. Outward display belongs not to the proceedings, and the expression of mutual compliment belongs not to the language of earnest minded men. We meet, gentlemen, if I comprehend our purpose rightly, to assist and encourage each other in the performance of the laborious daily tasks of detailed scientific investigation. A great thought may probably arise almost instantaneously in the mind—and the intuition of genius may almost as immediately recongize its importance, and partly foresee its consequences. Individual labor may also do much in establishing the truth of a new principle of theory; but what an amount of labor may its multifarious applications involve! Nearly two centuries have not sufficed to work out all the consequences of the principle of gravitation. Every theory as it becomes more and more perfectly worked out embraces a greater number of phenomena, and requires a greater number of laborers for its complete development. Thus it is that when science has arrived at a certain stage, combination and co-operation become so essential for its further progress. Each scientific Society effects this object in a greater or less degree—but much of its influence may be of a local character, and it is usually restricted by a limited range of its objects. Up to a certain point no means are probably so effective for the promotion of science as those particular societies which devote themselves to one particular branch of science; but as each science expands, it comes into nearer relations with other sciences, and a period must arrive in this general and progressive advance which must render the co-operation of the cultivators of different branches of science almost as essential to our general progress as the combination of those who cultivate the same branch was essential to the progress of each particular science in its earlier stages. It is the feeling of the necessity of combination and of facility of intercourse among men of science that has given rise to a strong wish that the scientific Memoirs of different Societies should be rendered, by some general plan, more easily and generally accessible than they are at present:—a subject which I would press on your consideration. It is by promoting this combination that the British Association has been able to exert so beneficial an influence—by bringing scientific men together, and thus placing, as it were, in juxtaposition every Society in the country. But how has this influence been exercised? Not assuredly in the promotion of vague theories and speculative novelties; but in the encouragement of the hard daily toil of scientific research, and by the work which it has caused to be done, whether by its influence over individual members or on the Government of the country. Regarding our Association, gentlemen, in this point of view, I can only see an increased demand for its labors, and not a termination of them, in the future progress of science. The wider the spread of science, the wider will be the sphere of its usefulness.

We should do little justice to the great Industrial Exhibition, which, two years ago, may be literally said to have delighted millions of visitors, or to the views of the illustrious Prince with whom it originated, if we should merely recollect it as a spectacle of surpassing beauty. It appears destined to exercise a lasting influence on the mental culture, and therefore, we may hope, on the moral condition, of the great mass of our population, by the impulse which it has given to measures for the promotion of general education. We may hope that those whose duty it will be to give effect to this impulse, will feel the importance of education in Science as united with education in Art. An attempt to cultivate the taste alone, independently of the more general cultivation of the mind, would probably fail, as it would deserve to do. I trust that the better education which is now so universally recognized as essential to preserve our future pre-eminence as a manufacturing nation, will have its foundations laid, not in the superficial teaching which aims only at communicating a few curious results, but in the sound teaching of the fundamental and elementary principles of science. Art ought assuredly to rest on the foundation of Science. Will it, in the present day, be contended that the study of Science is unfavorable to the cultivation of taste? Such an opinion could be based only on an imperfect conception of the objects of Science, and an ignorance of all its rightful influences. Does the great sculptor or the historical painter despise anatomy? On the contrary, he knows that a knowledge of that science must constitute one of the most valuable elements of his art if he would produce the most vigorous and characteristic expression of the human figure. And so the artist should understand the structure of the leaf, the tendril, or the flower, if he would make their delicate and characteristic beauties

subservient either to the objects of decorative art, or to those of the higher branches of sculpture and painting. Again, will the artist appreciate less the sublimity of the mountain, or represent its characteristic features with less truthfulness, because he is sufficient of a geologist to trace the essential relations between its external form and its internal constitution? Will the beauty of the lake be less perfectly imitated by him if he possess a complete knowledge of the laws of reflection of light? Or will he not seize with nicer discrimination all those varied and delicate beauties which depend on the varying atmosphere of our own region, if he have some accurate knowledge of the theory of colors, and of the causes which govern the changeful aspects of mist and cloud? It is true, that the genius and acute powers of observation of the more distinguished artists may compensate, in a great degree, for the want of scientific knowledge; but it is certain that a great part of the defects in the works of artists of every description may be traced to the defect of scientific knowledge of the objects represented. And hence it is that I express the hope that the directors of the important educational movement which is now commencing with reference to industrial objects will feel the necessity of laying a foundation, not in the complicated details of science, but in the simple and elementary principles which may place the student in a position to cultivate afterwards, by his own exertions, a more matured acquaintance with those particular branches of science which may be more immediately related to his especial avocations. If this be done, abstract science will become of increased estimation in every rank of society, and its value, with reference at least to its practical application, will be far better understood than it is generally at the present time.

Under such circumstances, the British Association could not fail to become of increased importance, and the sphere of its usefulness to be enlarged. One great duty which we owe to the public, is to encourage the application of abstract science to the practical purposes of life—to bring, as it were, the study and the laboratory into juxtaposition with the workshop. And, doubtless, it is one great object of science to bring more easily within reach of every part of the community the rational enjoyments, as well as the necessaries of life; and thus not merely to contribute to the luxuries of the rich, but to minister also to the comforts of the poor,—and to promote that general enlightenment so essential to our moral progress and to the real advance of civilization. But still, we should not be taking that higher view of science which I would wish to inculcate, if we merely regarded it as the means of supplying more adequately the physical wants of man. If we would view science under its noblest aspects, we must regard it with reference to man, not merely as a creature of physical wants, but as a being of intellectual and moral endowments, fitting him to discover and comprehend some part at least of the laws which govern the material universe, to admire the harmony which pervades it, and to love and worship its Creator. It is for Science, as it leads to this contemplation of Nature, and to a stronger sense of the beauties which God has spread around us, that I would claim you deeper reverence. Let us cultivate science for its own sake, as well as for the practical advantages which flow from it. Nor let it be feared lest this cultivation of what I may term contemplative science, if prosecuted in a really philosophic spirit, should inspire us with vain and presumptious thoughts, or disqualify us for the due appreciation of moral evidence on the most sacred and important subjects which can occupy our minds. There is far more vanity and presumption in ignorance than in sound knowledge; and the spirit of true philosophy, be it ever remembered, is a patient, a modest, and a humble spirit.

At the close of this Address, a vote of thanks to the President was, as usual, passed.

ON SOME OF THE ERUPTIVE PHENOMENA OF ICELAND.

BY DR JOHN TYNDALL, F.R.S.*

The surface of Iceland slopes gradually from the coast towards the center, where the general level is about two thousand feet above the surface of the sea. On this, as a pedestal, are planted the Jokul, or icy mountains of the region, which extend both ways in a north-easterly direction. Along this chain the active volcanoes of the island are encountered, and in the same general direction the thermal springs occur, thus suggesting a common origin for them and the volcanoes. From the ridges and chasms which diverge from the mountains, mighty masses of steam are observed to issue at intervals, hissing and roaring, and where the escape takes place at the mouth of a cavern and the resonance of the cave lends its aid, the sound is like that of thunder. Lower down in the more porous strata we have smoking muddy pools, where a repulsive blue-black aluminous paste is boiled, rising at times into huge bladders, which on bursting, scatter their slimy spray to a height of fifteen or twenty feet. From the base of the hills upward extend the glaciers, and on their shoulders are placed the immense snow-fields

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which crown the summits. From the arches and fissures of the glaciers, vast masses of water issue, falling at times in cascades over walls of ice, and spreading for miles and miles over the country before they find a definite outlet. Extensive morasses are thus formed, which lend their comfortless monotony to the dismal scene already before the traveler's eye. Intercepted by the cracks and fissures of the land, a portion of these waters is conducted to the hot rocks underneath; here meeting with the volcanic gases which traverse these underground regions, both travel together, to issue at the first convenient opportunity either as an eruption of steam, or as a boiling spring.

The origin of the water which feeds the springs is here hinted at. That origin is atmospheric. The summits of the Jokul arrest and mix the clouds, and thus cause an extraordinary deposition of snow and rain. This snow and rain constitute the source from which these springs are fed. The nitrogen and ammonia which occur, without exception, in every spring, exactly as we find them in rain-water, furnish the proof of this; for the known deportment of these substances preclude them from being regarded as real volcanic products.

The springs of Iceland permit of being divided into two great classes; one class turns litmus paper red, the other restores the color; one class is acid, the other alkaline. Periodical eruptions are scarcely ever known to occur among the former, while to the latter belong the Geisers of the island. Here then we have two facts which form the termini of a certain chain of operations—the water of the clouds and the water of the spring: in its passage from one terminus to the other is to be sought the cause of those changes which the water has undergone.

In seeking insight here, experiment is our only safe guide. Let us endeavor to combine the agencies of nature, and see whether we can not produce her results. Sulphurous acid is one of the most important gases which the water encounters in its passage. Now if a piece of palagonite, the rock through which the water filters, be heated with an excess of aqueous sulphurous acid, it dissolves in the cold to a fluid colored yellow brown by the presence of peroxide of iron. On heating the fluid this peroxide is converted into protoxide; a portion of the oxygen goes to the sulphurous acid, forming sulphuric acid, which combines with the bases of the rock and holds them in solution. This is the first stage of the fumarole process. But if the process ended here, we might expect to find the dissolved constituents of the rock in the resultant spring, which is by no means the case, as a glance at the following table will show.

Relation of Bases.

	In Palagonite.	In the Suffion water.
Oxide of iron	36.75	0.00
Alumina	25.50	12,27
Lime	20.25	42.82
Magnesia	11.39	29.42
Soda	3.44	9.51
Potash	2.67	5.98
	100.00	100.00

We see here that the rock contains a large quantity of the oxide of iron, while the spring does not contain a trace of it. It is, however, an experimental fact that the oxide of iron has been dissolved with the rest. How is its disappearance to be accounted for? The very rock from which it was originally extracted possesses the power of re-precipitating it, when by further contact with the rock the solution which contains it has its excess of acid absorbed and has thus become neutral. In this way the aqueous sulphurous acid acts as a carrier to the iron, taking up its burden here and laying it down there; and this process of transference can be clearly traced in the rocks themselves. Where the iron has been extracted, the rock has become a mass of white clay, where the iron is redeposited the mass exhibits the color produced by iron. But it would weary the audience, and thus defeat the object of the lecture, were the details thus minutely dwelt upon. Let it suffice therefore to weld swiftly together the links of the great chain operations, to which the various thermal springs and gaseous eruptions of Iceland owe their existence and peculiarities.

Hydrochloric acid, though playing a far less important point in Iceland than at Vesuvius and Etna, is nevertheless present. The presence of common salt is proved by the fact of its being found as one of the products of sublimation. Now it is a well known fact that this substance, exposed to a high heat in the presence of silica and the vapor of water, is decomposed; the sodium takes the oxygen of the water and becomes soda, the chlorine takes the hydrogen and forms hydrochloric acid. There is no difficulty, therefore, in accounting for the origin of this gas, as all the conditions for its formation are present.

Sulphurous acid and sulphuretted hydrogen play a most important part in Iceland;—how can their presence be accounted for? Let a piece of one of the igneous rocks of the island be heated to redness, and permit the vapor of sulphur to pass over it. The oxide of iron of the rock is decomposed; a portion of the sulphur unites with the iron, which remains as sulphuret; the liberated oxygen unites with the remaining sulphnr, and forms sulphurous acid. Let the temperature of the heated mass sink till

it descends just below a red heat, and then let the vapor of water be passed over it; a decomposition of the sulphuret before formed is the consequence; the iron is reoxidized, and the liberated sulphur unites with the free hydrogen to form sulphuretted hydrogen, and thus the presence of two of the most important agents in these phenomena is to be accounted for. These are experimental facts capable of being repeated in the laboratory, and the chronological order of the gases thus produced is exactly the same as that observed in nature. In the active volcanoes, where the temperature is high, we have the sulphurous acid; in the dormant ones, where the temperature has sunk so far as to permit the decompositions just described, we have the sulphuretted hydrogen. This accounts for the irregular and simultaneous appearance of these two gases in various parts of the island. At Krisuvik, for example, exhalations of sulphurous acid, sulphuretted hydrogen, steam and sulphur,* burst in wild disorder from the hot ground. The first two gases can not exist amicably together. In Iceland they wage an incessant war, mutually decompose each other, and scatter their sulphur over the steaming fields. In this way the true solfataras of the island are formed.

In process of time, however, the heat retires to greater depths, the sources of the sulphurous acid and sulphuretted hydrogen become by degrees exhausted, and at such places the acid reaction of the soil disappears. Carbonic acid is found in abundance every where, but as long as the more powerful sulphuric acid is present the former must remain free. But when the acid reaction has disappeared, the carbonic acid combines with the alkaline bases, the bicarbonates thus formed impregnate the thermal waters, and become solvents for the silica which these waters are said to contain in such surprising abundance, and which, as we shall presently see, furnishes the materials for the wonderful architecture of the Geisers.

Casting our thoughts back upon the foregoing description, the hypothesis of internal heat will be seen to be implied, and from this as a *cause* we have deduced the various chemical phenomena as *consequences*. Holding fast by experiment, we see that the various gases whose existence has been urged as one of the strongest proofs of the so-called chemical theory, follow in the most natural and necessary manner from the rival supposition. Given the heat and the materials the results are such as any chemist acquainted with the reactions might predict *a priori*. By the labors of a chemist indeed a new and wonderful light has been thrown upon the entire volcanic phœnomena of Iceland. With implicit reliance on the application of his science to the solution of these phenomena, he has traveled side by side with nature, combined her conditions, and produced her effects. Basing all his reasoning upon experiment, he has given to his conclusions a stability which mere speculation, however plausible, could never claim. That chemist is Bunsen, to whose researches in Iceland the audience were indebted for the materials of the present discourse.

The Lecturer then adverted to the Geisers; and proposed, as his time was limited, to confine his attention to the Great Geiser. We have here a tube ten feet wide and seventy feet deep; it expands at its summit into a basin, which from north to south measures fifty-two feet across, and in the perpendicular direction sixty feet. The interior of the tube and basin is coated with a beautiful smooth plaster, so hard as to resist the blows of a hammer. The first question that presents itself is, how was this wonderful tube constructed? How was this perfect plaster laid on? A glance at the constitution of the Geiser water will perhaps furnish the first surmise. In 1000 parts of water the following constituents are found:

Silica	0.5097
Carbonate of Soda	0.1939
Carbonate of Ammonia	0.0083
Sulphate of Soda	0.1070
Sulphate of Potash	0.0475
Sulphate of Magnesia	0.0042
Chloride of Sodium	0.2521
Sulphide of Sodium	0.0088
Carbonic Acid	0.0557

The lining of the tube is silica, evidently derived from the water; and hence the conjecture may arise that the water deposited the substance against the sides of the tube and basin. But the water deposits no sediment even when cooled down to the freezing-point. It may be bottled up and kept for years as clear as crystal, and without the slightest precipitate. A specimen brought from Iceland and analysed in this Institution was found perfectly free from sediment. Further, an attempt to answer the question in this way would imply that we took it for granted that the shaft was made by some foreign agency and that the spring merely lined it. A painting of the Geiser—the property of Sir Henry Holland—himself an eye-witness of these wonderful phenomena,—was exhibited. The painting, from a sketch taken on the spot, may be relied on. We find here that the basin rests on the summit of a mound; this mound is about forty feet in height, and a glance at it is sufficient to show that it has been deposited by the Geiser. But, in building the mound, the spring must also have formed the tube which perforates the

* In nature the vapor of sulphur is doubtless derived from the action of heat upon certain sulphur compounds.

mound; and thus we learn that the Geiser is the atchitect of its own tube. If we place a quantity of the Geiser water in an evaporating basin, the following takes place: in the center the fluid deposits nothing, but at the edges where it is drawn up the sides of the basin by capillary attraction, and thus subjected to a quick evaporation, we find silica deposited; round the edge we find a ring of silica thus laid on, and not until the evaporation is continued for a considerable time, do we find the slightest turbidity in the central portions of the water. This experiment is the microscopic representant, if the term be permitted, of nature's operations in Iceland. Imagine the case of a simple thermal spring whose waters trickle over its side down a gentle incline; the water thus exposed evaporates speedily, and silica is deposited. This deposit gradually elevates the side over which the water passes until finally the latter has to choose another course; the same takes place here, the ground becomes elevated by the deposit as before, and the spring has to go forward—thus it is compelled to travel round and round, discharging its silica and deepening the shaft in which it dwells, until finally, in the course of centuries, the simple spring has produced that wonderful apparatus which has so long puzzled and astontonished both the traveler and the philosopher.

Before an eruption, the water fills both the tube and basin, detonations are heard at intervals, and after the detonation a violent ebullition in the basin is observed; the column of water in the pipe appears to be lifted up, thus forming a conical eminence in the centre of the basin and causing the water to flow over its rim. The detonations are evidently due to the production of steam in the subterranean depths, which rising into the cooler water of the tube, becomes condensed and produces explosions similar to those produced on a small scale when a flask of water is heated to boiling. Between the interval of two eruptions, the temperature of the water in the tube towards the centre and bottom gradually increases. Bunsen succeeded in determining its temperature a few minutes before a grand eruption took place; and these observations furnished to his clear intellect the key to the entire enigma. A little below the centre the water was within two degrees of its boiling point, that is, within two degrees of the point at which water boils under a pressure equal to that of an atmosphere, *plus the pressure of the superincumbent column of water*. The actual temperate at thirty feet above the bottom was 122° Centigrade, its boiling point here is 124°. We have just alluded to the detonations and the lifting of the Geiser column by the entrance of steam from beneath. These detonations and the accompanying elevation of the column are, as before stated, heard and observred at various intervals before an eruption. During these intervals the temperature of the water is gradually rising; let us see what *must* take place when its temperature is near the boiling-point. Imagine the section of water at thirty feet above the bottom by the generation of a mass of vapor below. The liquid spreads out in the basin, overflows its rim, and thus the elevated section has six feet less of water pressure upon it; its boiling-point under this diminished pressurd is 121°; hence in its new position, its actual temperature (122°) is a degree above the boiling-point. This excess is at once applied to the generation of steam; the column is lifted higher, and its pressure further lessened; more steam is developed underneath; and thus, after a few convulsive efforts, the water is ejected with immense velocity, and we have the Geiser eruption in all its grandeur. By its contact with the atmosphere the water is cooled, falls back into the basin, sinks into the tube through which it gradually rises again, and finally fills the basin. The detonations are heard at intervals, and ebullitions observed; but not until the temperature of the water in the tube has once more attained its boiling-point, is the lifting of the column able to produce an eruption.

In the regularly formed tube the water nowhere quite attains the boiling-point. In the canals which feed the tube, the steam which causes the detonation and lifting of the column must therefore be formed. These canals are in fact nothing more than the irregular continuation of the tube itself. The tube is therefore the sole and sufficient cause of the eruptions. Its sufficiency was experimentally shown during the lecture. A tube of galvanized iron six feet long was surmounted by a basin; a fire was placed underneath and one near its centre to imitate the lateral heating of the Geiser tube. At intervals of five or six minutes, throughout the lecture, eruptions took place; the water was discharged into the atmosphere, fell back into the basin, filled the tube, became heated again, and was discharged as before.

Sir Geo. Mackenzie it is well known was the first to introduce the idea of a subterranean cavern to account for the phenomena of the Geiser. His hypothesis met with general acceptance, and was even adopted undoubtingly by some of those who accompanied Bunsen to Iceland. It is unnecessary to introduce the solid objections, which might be urged against this hypothesis, for the tube being proved sufficient, the hypothetical cavern disappears with the necessity that gave it birth.

From the central portions of the Geiser tube downwards, the water has stored up an amount of heat capable, when liberated, of exerting an immense mechanical force. By an easy calculation it might be shown that the heat thus stored

up could generate, under ordinary atmospheric pressure, a column of steam having a section equal to that of the tube and a height of nearly *thirteen hundred yards*. This enormous force is brought into action by the lifting of the column and the lessening of the pressure described above.

A moment's reflection will suggest to us that there must be a limit to the operations of the Geiser. When the tube has reached such an altitude that the water in the depths below, owing to the increased pressure, cannot attain its boiling-point, the eruptions of necessity cease. The spring however continues to deposit its silica and forms a *laug* or cistern. Some of these in Iceland are of a depth of thirty or forty feet. Their beauty is indescribable; over the surface a light vapor curls, in the depths the water is of the purest azure, and tints with its own hue the the fantastic incrustations on the cistern walls; while at the bottom is observed the mouth of the once mighty Geiser. There are in Iceland traces of vast, but now extinct, Geiser operations. Mounds are observed whase shafts are filled with rubbish, the water having forced a way underneath and retired to other scenes of action. We have in fact the Geiser in its youth, manhood, old age, and death, here presented to us:—in its youth as a simple thermal spring, in its manhood as the eruptive spring, in its old age as the tranquil *laug*, while its death is recorded by the ruined shaft and mound which testify the fact of its once active existence.

Next to the Great Geiser the Stokkur is the the most eruptive spring of Iceland. The depth of its tube is forty-four feet. It is not however cylindrical like that of the Geiser, but funnel-shaped. At the mouth it is eight feet in diameter, but it diminishes gradually, until near the centre the diameter is only ten inches. By casting stones and peat into the tube and thus stopping it, eruptions can be forced which in point of height often exceed those of the Great Geiser. Its action was illustrated experimentally in the lecture, by stopping the galvanized iron tube before alluded to loosely with a cork. After some time the cork was forced up and the pent-up heat converting itself suddenly into steam, the water was ejected to a considerable height; thus demonstrating that in this case the tube alone is the sufficient cause of the phenomenon.

MANUFACTURE OF CAOUTCHOUC.

We take the following account of a new process of manufacturing Caoutchouc from the Practical Mechanics' Journal: it has been recently patented in England.

As in many other most valuable improvements in india-rubber manufacture, this important invention is a contribution from the United States, where it is now being most successfully worked out. Its object is the preparation of the raw juice or milk of the caoutchouc tree, in such manner that it shall remain in a fluid state without deterioration; together with the after treatment of the fluid matter, for the production of a new article or raw material of manufacture. Shortly after the milk or juice is collected, it is strained, and has then added to it a quantity of the concentrated liquor of ammonia, or other ammoniacal matter, or any combination of nitrogen and carbon. The mixture is then well mixed, when it will remain in a white fluid state, capable of transportation and use, as a preserved material, if kept in air-tight receptacles. For the production of a new article of manufacture from this composition, it is run out on a suitable surface, and submitted to slow evaporation. This gradually solidifies the layer so poured out, and the mass becomes a new article of manufacture, very elastic and tough and transparent, and suitable for all the ordinary uses of caoutchouc, as well as many others not yet in existence.

The milk is collected by tapping the trees in the ordinary manner, the liquid so obtained being permitted to flow into suitable vessels of clay. When the liquid is collected, and before it has time to sour from atmospheric exposure—that is to say, within about three hours from the time that the liquid is produced — it is strained through a cloth into a clean tin or glass vessel. When this is done, concentrated liquor of ammonia, or ammonia in any other form, or compounded to produce a like result, or any combination or compound of nitrogen and carbon, is added to the liquid or juice, in the proportion of about one fluid ounce of the liquor of ammonia, to one pound weight of the juice. In this mixture the concentrated liquor of ammonia is preferred as the added ingredient. After this admixture, the composition is thoroughly mixed up, so as to be perfectly incorporated. The composition so produced is still a liquid under exposure to the atmosphere, and its color remains equally as white as when drawn from the tree. In this state it may then be put up in air-tight cases or vessels for transportation, or after use, tin cases or glass bottles being used by preference for this purpose. When thus treated and packed, the mixture may be preserved for any reasonable length of time, and it may be conveyed to any part of the world, whilst it still retains its liquid state and pure white color, suitable for manufacturing purposes, and in many respects far superior to the smoked or common india-rubber of commerce.

For the production of a new and original article of manufacture from this substance, it is poured or run on to plates of glass or polished metal, or glazed paper or other suitable receiv-

ing surface, of the desired size and form. In this condition it is subjected to a slow atmospheric exaporation, either in the open air, or at the ordinary atmospheric temperature, or at a temperature of from 75 to 100 degrees of Fahrenheit. By this treatment, the liquid portion of the spread out mass is dissipated, leaving behind a solid mass, very elastic and tough, and comparatively transparent or translucent, and possessing properties distinct from all other known substances

ON THE CONDENSATION OF GASES AT THE SURFACE OF SOLID BODIES.

BY MM. J. JAMIN AND A. BERTRAND.

In the various experiments intended to establish the physical theory of gases, it is implicitly supposed that their state of equilibrium is not influenced by the walls of the vessel in which they are contained; it is supposed that no attractive or repulsive force exists between solid and gaseous molecules. Nevertheless the general principles of molecular physics do not justify our thinking that this can be the case; we have no reason to suppose that the gasès are deprived of a property so energetically manifested by liquids; and if it were so, we could not explain many phenomena which only require to be generalized in order to demonstrate the existence of this property.

Porous bodies present, in a very small space, a considerable amount of internal surface; the gases which penetrate into these substances lose their repulsive force, and accumulate in them as though by the influenee of an extremely energetic attractive force. The phenomenon of porous bodies may be compared to that of capillarity; and just as the elevation of water in a tube may serve to show the existence of attractions between liquids and glass, the absorption of gases by charcoal is a proof of the attraction which a solid, isolated and continuous surface may exert upon gases.

After ascertaining and measuring the absorption of gases by various porous bodies, DeSaussure called the attention of chemists to an important fact, namely, that he had proved that gases condensed in charcoal produced abnormal chemical actions; since that time Döbereiner discovered spongy platinum: these combinations, anticipated by De Saussure, became more evident but it was seen that they were preceded by a condensation of the gases, and, in fact, were the consequence of this; they consequently serve to prove it.

As soon as the discovery of Döbereiner was announced, Thenard and Dulong repeated the experiments with some variations. They ascertained that the properties of spongy platinum were possessed by all porous bodies; they found them to exist in thin leaves of all the metals, and even in pounded glass or porcelain. Now if these combinations be the consequence of condensation, it must be admitted that this condensation takes place upon the metallic leaves and on the fragments of glass.

To these various experiments we must add the leading fact announced by M. Pouillet,—the absorption of oxygen in a platinum thermometer, and the condensation of the vapor of water by glass.

Moreover, this general idea admitted by geometricians, has often constituted the study of physicists, who, not hoping to prove it directly, have sought to verify it by indirect but very precise experiments. M. Arago proposed to cause the interference of two rays of light passing through the air, the one at a certain distance from, the other in contact with, a solid surface; he has recently returned to the same question, making use of the oscillations of a magnetized needle.

There exist, therefore, indirect proofs, which however to us appear conclusive, of the condensation of gases by solid surfaces; thus it was with nearly a certainty of success that we undertook the following experiments.

We filled glass vessels, which had been carefully measured, with pulverized solid substances; we ascertained the densities of the powders and the quantities contained in the vessels, and we had all the elements necessary for calculating the space left free.

Thus arranged, the vessels were connected with a good air-pump and with a manometer with two branches; one of the two branches was open to the air, it allowed the pressures to be ascertained; the other was closed, and communicated with the vessel by a tube and stopcock; it served to measure a constant volume of gas, which was then driven into the vessel, by causing the mercury to rise. At each introduction of gas the pressure increased by a quantity which was measured, and which could be calculated by Mariotte's law; the results of the experiment and of calculation were compared.

In this manner we have operated upon very various substances,—Fontainbleau sand, pounded glass of different degrees of fineness, and metallic filings and oxides. We have always found that the pressure observed was less than that calculated; we have therefore concluded that the gases were absorbed by the solid substances.

These absorptions present great analogy with those manifested by porous bodies; they are not produced instantaneously, but continue several hours, only attaining their limit after a period which may be prolonged at pleasure; they vary in intensity according to the nature of the

gas employed, being weak with hydrogen, stronger with atmospheric air, and very considerable with carbonic acid. We shall give their measure by the following results, obtained with pounded glass, washed and dried; the free space was 590 cubic centimetres, in which a vacuum was produced, and the gas was then allowed to fill it under the atmospheric pressure; it absorbed—

Carbonic acid.	Air.	Hydrogen.
645	602	595

We are convinced, moreover, that the preceding results are too low, and that it is impossible to measure exactly the quantities of gas contained in such spaces. When a vacuum is produced in them, the equilibrium of pressure is evidently re-established very slowly; the air-pump must be worked several hours to obtain a vacuum within 1 millimetre; and besides this, pressure does not remain constant, it gradually increases, and the action of the machine must be recommended without ever being able to attain the maximum vacum which it is capable of producing. The condensation attained is the more energetic according to the goodness of the vacuum produced; but it is necessary to remember that its exact measure is never obtained.

Carbonic acid manifests these properties very energetically; when the powder with which the glass vessel is filled, whatever may be its nature, is exposed to this gas for the first time, it absorbs it rapidly, but on a second operation it has partially lost this property. The vessel already mentioned received, after evacuation, successive equal charges of this gas; the increase of pressure which they produced were measured, and by calculating the volume of the vessel by Mariotte's law, there were found—

721 cub. cent. 636 cub. cent. 629 cub. cent. 6.7 cub. c. 622 cub. c.

After these experiments a vacuum of the same degree was again produced, and the same successive introductions of gas being effected, gave—

644 cub. cent. 630 cub. cent. 621 cub. cent. 620 cub. c. 616 cub. c

From these results we must conclude,—1, that the absorption takes place with the more energy in proportion as the original pressure is weaker; 2, that after having once absorbed a gas, the solid substance retains a considerable portion of it, of which it cannot be deprived, and which causes a proportionable diminution in its power of condensation.

These experiments require particular care, and can only be reproduced with very accurate apparatus; we will, however, describe one which any one may repeat without difficulty, and which will exhibit our results in a conclusive manner.

A fine powder (pounded glass or oxide of zinc) is mixed in a mortar with water which has been deprived of air, so as to form a clear paste without any bubbles of gas; this is poured into a flask with a long neck until it fills two-thirds of the bulb. After a short time the solid substance is deposited with a layer of water above it. A vacuum is then produced in the flask; at the first strokes of the piston the water rises, increases in volume so as to fill the flask, but no bubble of air makes it appearance; and if the cock of the air-pump be suddenly opened, the pressure is reproduced, and the fluid returns to its original volume with a rapidity which shakes the flask, and a sound like that of a water-hammer. If the experiment be prolonged, and the vacuum completely formed, noticeable quantities of bubbles are produced.—*Comptes Rendus*, June 6, 1853, p. 994.

NEW PHOTOGRAPHIC PROCESS.

Henley street, July 6.

Your insertion of the annexed letter from my brother-in-law, Mr. John Stewart, of Pau, will much oblige me. The utility of this mode of reproduction seems indisputable. In reference to its concluding paragraph, I will only add, that the publication of concentrated microscopic editions of works of reference—maps, atlases, logarithmic tables, or the concentration for pocket use of private notes and MSS., &c., &c., and innumerable other similar applications—is brought within the reach of any one who possesses a small achromatic object-glass of an inch or an inch and a half in diameter, and a brass tube, with slides before and behind the lens of a fitting diameter to receive the plate or plates to be operated upon—central or nearly central rays only being required. The details are too obvious to need mention. I am, &c.,

J. F. W. Herschell.

Dear Herschell: I sent you some time ago a few small sized studies of animals from the life, singly and in flocks, upon collodionized glass. The great rapidity of exposition required for such subjects, being but the fraction of a second, together with the very considerable depth and harmony obtained, gave me reason to hope that ere this I should have been able to produce microscopic pictures of animated objects. For the present I have been interrupted. Meantime, one of my friends here, Mr. Heilmann, following the same pursuit, has lighted on an ingenious method of taking from glass negatives positive impressions of different dimensions, and with all the delicate minuteness which the negative may possess. This discovery is likely, I to extend the resources and the application of photography—and with some

modifications, which I will explain, to increase the power of reproduction to an almost unlimited amount. The plan is as follows:—The negative to be reproduced is plased in a slider at one end (a) of a camera or other box, constructed to exclude the light throughout. The surface prepared for the reception of the positive—whether albumen, collodion, or paper—is placed in another slider, as usual, at the opposite extremity (c) of the box, and intermediately between the two extremities (at b) is placed a lens. The negative at a is presented to the light of the sky, care being taken that no rays enter the box but those traversing the partly transparent negative. The rays are received and directed by the lens at b upon the sensitive surface at c, and the impression of the negative is there produced with a rapidity proportioned to the light admitted, and the sensibility of the surface presented. By varying the distances between a and c, any dimensions required may be given to the positive. I have obtained negatives four times larger than the original, and other impressions reduced thirty times, capable of figuring on a watch-glass, brooch, or ring.

"Undoubtedly one of the most interesting and important advantages gained by this simple arrangement is, the power of varying the dimensions of a picture or portrait. Collodion giving results of almost microscopic minuteness, such negatives bear enlarging considerably without any very perceptible deterioration in that respect. Indeed, as regards portraits, there is a gain instead of a loss; the power of obtaining good and pleasing likenesses appears to be decidedly increased, the facility of subsequent enlargement permitting tnem to be taken sufficiently small, at a sufficient distance (and therefore with greater rapidity and certainty) to avoid all the focal distortion so much complained of—while the due enlargement of a portrait taken on glass has the effect, moreover, of depriving it of that hardness of outline so objectionable in a collodion portrait, giving it more artistic effect, and this without quitting the perfect focal point as has been suggested.

"But there are many other advantages by this process. For copying by engraving, &c., the exact dimensions required of any picture may at once be given to be copied from.

"A very small photographic apparatus can thus be employed, when a large one might be inconvenient or impracticable, the power of reproducing on a larger scale being always in reserve. Independent of this power of varying the size, positives so taken of the *same* dimension as the negative, reproduce, as will be readily understood, much more completely the finer and more delicate details of the negatives than positives taken by any other process that I am acquainted with.

"The negative also may be reversed in its position at a so as to produce upon glass a positive to be seen either upon or under the glass. And while the rapidity and facility of printing are the same as in the case of positives taken on paper prepared with the iodide of silver, the negatives, those on glass particularly, being so easily injured, are much better preserved, all actual contact with the positive being avoided. For the same reason, by this process positive impressions can be obtained not only on wet paper, &c., but upon hard, inflexible substances, such as porcelain, ivory, glass, &c.—and upon this last, the positives being transparent are applicable to the stereoscope, magic lantern, &c.

"By adopting the following arrangement, this process may be used largely to increase the power and speed of reproduction with little loss of effect. From a positive thus obtained, say on collodion, *several hundred* negatives may be produced either on paper, or on albumenized glass. If on the latter, and the dimensions of the original negative is preserved, the loss in minuteness of detail and harmony is almost imperceptible, and even when considerably enlarged, is so trifling as in the majority of cases to prove no objection, in comparison with the advantages gained in size. Thus, by the simultaneous action, if necessary, of some hundreds of negatives, many thousand impressions of the same picture may be produced in the course of a day.

"I cannot but think, therefore, that this simple but ingenious discovery will prove a valuable addition to our stock of photographic manipulatory process. It happily turns to account, and utilizes one of the chief excellencies of collodion—that extreme minuteness of detail which from its excess becomes almost a defect at times—toning it down by increase of size till the harshness is much diminished, and landscapes, always more or less unpleasing on collodion from that cause, are rendered somewhat less dry and crude.

"A very little practice will suffice to show the operator the quality of glass negatives—I mean as to vigor and development—best adapted for reproducing positives by this method. He will also find that a great power of correction is obtained, by which overdone parts in the negative can be reduced and others brought up. Indeed, in consequence of this and other advantages, I have little doubt that this process will be generally adopted in portrait taking.

"Should your old idea of preserving public records in a concentrated form on microscopic negatives ever be adopted, the immediate positive reproduction on an enlarged readable scale, without the possibility of injury to the plate, will be of service. I am, &c. JNO. STEWART."
—*Athenæum.*

PROCEEDINGS OF THE CLEVELAND ACADEMY OF NATURAL SCIENCES.

REGULAR MEETING, JAN'Y 24, 1854.

Dr. GARLICK presented a verbal report on the viviparous nature of certain Fishes.

Dr. ACKLEY made some communications in regard to the Rattlesnake.

The following gentlemen were elected corresponding members of the Society:

Dr. W. J. BURNETT, Boston, Mass.
Dr. J. L. LECONTE, Philadelphia, Pa.
Dr. R. P. HOY, Racine, Wis.
Dr. R. W. GIBBS, New York City.
Dr. JOHN A. WARDER, Cincinnati, O.
Prof. S. F. BAIRD, Washington, D. C.
Prof. J. L. SMITH, Louisville, Ky.
Prof. CHAS. GIRARD, Washington, D. C.
Prof. S. S. HALDEMAN, Columbia, Pa.
W. C. REDFIELD, Esq., New York City.

JAN'Y 31, 1854.

Dr. GARLICK exhibited specimens of ova of the Trout, artificially impregnated, in various stages of development.

The Secretary presented a paper, by H. K. BROWNE, Esq., which was referred to a special committee.

Dr. ACKLEY presented some further remarks in relation to the Rattlesnake.

Prof. ST. JOHN presented a letter from Mr MILLER, on some Drift phenomena, which was referred to a committee.

FEB'Y 7, 1854.

Committee on Mr. MILLER's letter recommended its publication.

Prof. SMITH exhibited specimens of Tænia. The head was exhibited under the microscope, showing the four bothrya and the hooklets.

Prof. KIRTLAND read a revision of the species Esox, inhabiting Lake Erie and its tributaries, with descriptions of two new species, *E. umbrosus* K., from Rocky River, and *E. Ohioensis* K., from the Mahoning.

Dr. GARLICK exhibited *casts* of two species of Esox, and gave the Society a description of his mode of taking casts of fishes.

Dr. NEWBERRY exhibited specimens of a new species of Sigillaria, from Marietta, O.

Mr. GEORGE SMITH exhibited specimens of *Cypris*, which had been sent from Cincinnati as a Cyclas. Referred to a special committee.

FEB'Y 14, 1854.

Prof. KIRTLAND exhibited a specimen of the Oneida Mouse, *Arvicola Oneida*, De Kay, from Rockport, O. Also, a new species of Fox, from Northern Ohio.

Dr. NEWBERRY presented specimens of *Cnemidophorus tigris*, B. & G., *Elgaria scincicorda*, B. & G., *Phrynosorna coronata*, Blainv., with some insects, minerals and tripoli from California.

ON THE ARTIFICIAL RE-PRODUCTION OF FISHES.

BY THEODATUS GARLICK M. D.

Read before the Cleveland Academy of Natural Science, February, 7. 1854.

The successful experiments of Messrs. Remy and Gehin, of France, in the artificial re-production of certain kinds of fishes, will without doubt, be repeatedly made in this and other countries, and with the same satisfactory results.

The immense advantages resulting from this discovery, particularly, in countries abounding with such a variety and extent of inland waters as our own, can hardly be estimated.

Early in the spring of last year, Prof. H. A. Ackley and myself determined to make the experiment of artificially breeding fishes. After, some deliberation, we determined to select the speckled trout, (*Salmo fontinalis*) for our first experiment. Accordingly in the month of August last I started for the Saut Ste. Marie, with the purpose of obtaining the parent fishes, while Prof. Ackley, was preparing a suitable place for their reception, by bnilding a dam across a very fine large spring of water on his farm, some two miles from this city.

There was no difficulty in capturing as many as I desired, but it was quite another kind of sport to transport them alive a distance of near six hundred miles. After various vexations, among which was the loss of the first shipment, we succeeded in getting down three lots, in all, about one hundred and fifty in fine condition, and lodged them safely in their new home, where they seemed as happy, and as sportive as they were in the beautiful blue waters of Lake Superior.

In the month of September I made a trip to Port Stanley, Canada, for another lot, and succeeded in getting home about forty more specimens, constituting certainly a very fair beginning to our enterprise.

We did not, however, expect to rear any young fishes this season, for we supposed the vicissitudes they were subjected to, such as their transportation, &c., would prevent them from depositing their eggs, but in this we were most agreeably disappointed, for on the 15th of November we discovered unmistakable evidences that they we about to engage in this interesting process.

Several male trout had proceeded up the stream, and commenced preparing the beds in

which the eggs were to be deposited. This was done by removing all the sediment, and sand, from certain gravelly locations. These beds were about one foot in diameter, consisting of coarse and fine pebbles, the spaces or interstices between which were to be the future depository for the eggs. This peculiar construction of their beds, or nests, is highly essential to their preservation, as it protects them from being washed away by freshets, also from being devoured by small fishes, which are always prowling about, seeking them for food.

The male trout at this time was very beautiful, being decked out in the most gaudy colors imaginable, and his actions showed clearly enough, that he was quite vain of his personal appearance.

In the course of four or five days, the females made their appearance. They were not near so gaudy in their dress, but had a most staid and matronly look.

The next step was choosing their mates. After the usual amount of flattering attentions to the females, with which they seemed highly delighted, and, some battles among the males, this important matter was settled apparently to the satisfaction of all parties. By what principles they were governed in making their selections I was unable to determine, but presume in this respect they are like men, governed more by fancy than judgment.

On the 20th of November they had fairly commenced operations, one pair of fish occupying each bed ; the male manifesting the utmost jealousy, and if any suspicious interloper approached, he was instantaneously attacked and driven off. On the 21st, I captured a pair by means of a landing net, and placed them in a bucket of water, and being provided with an earthen vessel, I made my first attempt at artificially spawning and impregnating the eggs. This was accomplished as follows :

I partially filled the earthen vessel with water, and taking the female in my left hand, and making gentle pressure on her abdomen with my right, the eggs were forced into the earthen vessel containing the water ; the male was treated in precisely the same manner, forcing the spermatic fluid into the same vessel ; the appearance of the eggs, was almost immediately changed from their bright golden orange color, to a pale transparent yellow ; they were then placed in running water with the vessel containing them.

On the 9th of January one of the eggs was placed under one of Dr. Goadby's microscopes. (The Dr. was at the time giving a course of lectures in this city.) Its appearance delighted the company of scientific gentlemen present, as well as myself. The egg, which at first had been a simple cell, was now multiplied into a countless number of cells, of different sizes, with traces of blood vessels; the eyes also being perceptible.

On the 22d of January we examined them again, and to our joy we found a young fish which had just left its narrow place of confinement, to try its new mode of existence ; it was very lively in its motions, but could not be considered an expert swimmer, owing to an appendage to its abdomen, of nearly the size of the egg, which in fact it was, and contained the material for the further development of the yet very imperfect fish ; this sack was filled with a multitude of minute cells, whose absorption keeps pace with the development of the fish. When the young fish leaves its egg, it measures about half an inch in length, neither the mouth, gills, nor any of the abdominal viscera are visible, all of which would be plainly discerned with the microscope, if they existed, owing to its almost perfect transparency. The heart, with the principal blood vessels, and even the corpuscles of blood, are beautifully shown with a microscope of moderate power. Their external appearance is remarkable. The eyes are large and quite well developed, the pectoral fins are also in an advanced stage of development, and in constant and rapid motion, which I think, in the more advanced stage of the fish has something to do with its respiration, as they are placed near the opening of the gill covers. The other portions of the fish are quite rudimentary no other fins being perceptible, but in their place there is an attenuated margin, or finlike substance, as on the tail of the tadpole, commencing where the dorsal fin should be, and continuing uninterruptedly around the caudal, and terminating with the anal fin, or rather where it should be.

This finlike substance undergoes a constant change as the fish grows older. At fourteen days the dorsal, adipose, caudal, and anal fins, are plainly seen, but as yet none of them have rays, except the caudal, in which they are very distinct. The rays of the caudal fin are first apparent at the center, although the general form of the rudimentary tail is very unsymmetrical, the superior lobe being the larger, and the outline not unlike that of the tails of many heterocercal fishes. At this age the fish has more than doubled its former length, the mouth, gills and abdominal viscera are visible, and it manifests a desire to take food, by nibbling at the unhatched eggs, and pieces of meat placed in the vessel containing them. Its color is now materially changed, being of darkish grey on its back and upper portions of its side. The sack suspended from the abdomen at this time becomes smaller, and less globular in form, being more contracted anteriorly, than posteriorly. The habits of the little creature

are also much changed, as it now swims smartly, and endeavors to hide itself whenever disturbed.

Owing to imperfections in our arrangements where we placed the eggs for hatching, accumulations of sediment buried them up, destroying them by hundreds; this accumulation was much more fatal when the embryo fish was nearly ready to make its exit from the egg. To avoid their further destruction, on the 26th of January we brought the remaining eggs to our office and placed them in a glass jar and supplied them, and the young fish, with fresh water daily. In this situation they have remained until the present time, the young fish making their appearance from day to day, the last one rupturing its oval envelope on the 10th day of February. I have seen as many as six make their appearance in as many as minutes. The temperature of the water at the spring was 42° Fahrenheit. Since they were brought to the office the water in which they have been kept has varied from 42° to 50°.

This experiment has afforded us one of the finest opportunities to be desired for the study of embryology, but professional duties have prevented us from making as minute observation as we could have wished. We have, however, repeatedly and distinctly seen the blood corpuscles in the returning veins enter the auricle of the heart and then pass into the venticles, and from thence into the aorta. Altogether, it has afforded us one of the most pleasing and instructive lessons in the early stages of animal existence that we have ever had, and I hope that some person of more accurate powers of observation, and having more leisure, will avail himself of these facilities which are within the reach of every man, and give to the world a more extended statement of facts than I have been able to do.

Another fact, in which all are interested, has been clearly demonstrated, every one who may be so fortunate as to possess a spring of water of moderate size can rear this charming fish in great numbers, and the streams that have been depopulated by the untiring zeal of the angler, can be replenished with a little trouble and at a small expense. Such streams as are not suited to the trout can be stocked with other choice varieties of fish with the same ease.

The number of eggs produced by a single female trout in one season has been variously stated by different writers, but it is a moderate statement to say that it is many thousands. A word to those who may wish to make the experiment and I have done.

The attempt should only be made when the eggs are mature; to be secure in this it will be best for the beginner to take the parent fishes when they are engaged in depositing the eggs. After the eggs are forced into the vessel containing the water, they should be stirred about a little, the water poured off, and the vessel filled again before the spermatic fluid is added, after which, the water should be a second time agitated in order that it may come in contact with all the eggs; this is necessary to the impregnation of all of them. They should then be placed where they can have running water constantly passing over them. This may be done by having a series of boxes partly filled with coarse sand and gravel, each placed below the other in the form of a stairway, the water passing from the first box to the second and so on. It would also be well to have the bottoms of the boxes pierced with small holes in order to prevent the sediment from accumulating, which is very destructive to the eggs,

These general rules if followed will be sure to crown the effort with success.

DIURNAL LEPIDOPTERA OF NORTHERN AND MIDDLE OHIO.

BY PROF. J. P. KIRTLAND.

Read before the Cleveland Academy of Natural Sciences.

[Continued from page 46.]

No. 15. ARGYNNIS IDALIA.—This showy species I have found abundant in Connecticut and Wisconsin, while in Northern Ohio I have never met with it, but have obtained a few specimens from Dayton. Why it should exist both east and west of us, and not in this locality, is an interesting fact, explainable only upon the supposition that our vicinity does not furnish suitable food for its larva. Of what that consists, I have not been able to ascertain. Drury, Boisduval and Leconte, have figured and described this butterfly, but neither have furnished any light on this point.

No. 16. A. APHRODITE.—One of our most common species. Its successive generations are constantly appearing during spring and summer, but the greatest number are met with early in autumn. The beautiful display of large and numerous silvery spots on the under surface of its wings, render it an interesting object to the eye of every observer.

No. 17. A. BELLONA.—This smaller species is equally abundant with the preceding. The food of the larva unknown to me.

No. 18. MELITÆA PHAETON.—In one instance only have I seen this species in Northern Ohio. A few specimens, captured at Dayton, I observed in the cabinet of the late Wm. Jenison, of that city.

No. 19. M. MYRINA.—In the same cabinet I observed this species, from the same locality,

and have met with it very rarely at the north. Like Argynnis Idalia, it is abundant in the States of Connecticut and Wisconsin.

No. 20. M. Tharos.—A common species.

No. 21. Vanessa Antiopa.—Though a species introduced from Europe, it has become very common. It often in its perfect state survives over winter, and may be seen flying during the first days of spring. The larva, which often feeds on the foliage of the lombardy poplar, excited strong prejudice some years since against such trees, from an erroneous belief that their tenant was venomous, like Cleopatra's asp.

No. 22. V. J. Album.—Appears in small numbers during spring, and again in autumn. It seems to have a predilection for ripe or decaying fruit, and often visits our cider mills, where apples are collected in large quantities. The food of its larva I have not been able to ascertain.

No. 23. V. Interrogationis.—Is frequently seen about our hop vines, upon which its larva frequently feeds.

No. 24. V. Comma.—This, like the preceding, is seen about our hop vines, but occurs in greater abundance.

No. 25. V. Progne.—A far less common species; is occasionally to be seen about our gardens and lawns, especially if elm trees are in the vicinity;—upon them the larva feeds.

No. 26. V. Furcillata.—Solitary specimens are occasionally met with on the margins of our forests early in spring, and at that time are usually found alighting on the dry leaves, in sunny exposures, apparently for the purpose of receiving warmth. In autumn they are sometimes more numerous. The food of the larva I have not been able to detect; nor do Say, Kirby, Boisduval, and Le Conte, who have described the species, afford any information on this point. The four last named species of Vanessa very closely resemble each other to a superficial observer, yet their specific characters are clear and satisfactory to one capable of making close investigation.

No. 27. Cynthia Atalanta—[*Painted Lady.*]—Though it is said to be an introduced species, it is common in every section of our Western States in which I am acquainted. The larva feeds indiscriminately on all the species of the nettle.

No. 28. C. Cardui.—This, like the preceding, is an introduced species, which in some seasons becomes extremely numerous, while in others the collector of insects will hardly discover a solitary individual. All the thistle family are eaten by the Larva. Even the forbidding Canada thistle I found in Wisconsin, to be stripped of its leaves by the larva.

No. 29. Cynthia Hunterii.—To a superficial observer this, and No. 28, resemble each other, but this is a native species with only two eye-like spots on the under surface of the hind-wings. The *Cardui* has spots of less size on the same part. The present species feeds while in the larva state on the mouse-ear, and everlasting.

No. 30. Apatura Celtis, is figured in Boisduval and Le Conte, but no description of it is furnished in their unfinished publication. The larva is supposed to feed on the Celtis. One specimen was taken at Dayton two years since, and was presented to me by the late Mr. Jenison.

No. 31. Satyrus Alope.—To the same respectable entomolgist I was indebted for a pair of this insect. Another specimen I have received from West Chester, N. Y., and also observed it in Wisconsin. It seems not to be very abundant in any known locality. All the species of this genus feed upon coarse grasses.

32. Satyrus Canthus.—In Northern Ohio this species is somewhat rare, while in the center of the State and especially in the Western prairies it is excessively abundant.

33. Satyrus Eurythius, is subject to the same remarks.

34. Satyrus Andromacha is among the most rare of our butterflies and even on our prairies is only occasionally seen.

35. Limenitis Ephistion.—This is an abundant species in every locality.

36. Lymenitis Arthemis is rarely seen in this vicinity, I have met with it in only two or three instances in Ohio. At Racine it is more common among the oak forests. It is one of our most active and handsome butterflies, though its plumage is plain. From its resorting almost exclusively to oak forests, it is inferred that the larva obtains its sustenance from that tree.

No. 37. Lymenitis Missippus.—This species is equally common with No. 35. The larva is found upon several species of oak.

No. 38. Danaus Archippus.—To a common observer this and the preceding species closely resemble each other, but the larva of the former has some spinous appendages which are not found on this, and the crysalid of the one has a romannose-like protrusion on its side while the other is uniformly cylindrical, without any appendage and is green, decked with gilt spots.

No. 39. Lycæna Americana.—This little and common species resembles the European analogue, but is specifically distinct. Early in the spring a small green worm which is the larva may be found in considerable numbers upon the leaf of dock and sorrel.

No. 40. Thecla Favonius.—This plain species is occasionally seen hovering about oak bushes yet it is among our most rare species. At Catskill, on the Hudson river, I once saw numbers of them.

No. 41. THECLA HUMULI.—This is sometimes found among our hop vines.

No. 42. POLYOMMATUS PSEUDARGIOLUS, and three other species are frequently seen about our gardens and fields, though from their small size they attract little attention. The food of their larvæ is not known to us.

No. 46. LIBYTHEA BACHMANII.—I first discovered this new species in Mahoning County, O., many years since but learned nothing of its habits. Last summer I met with a number of specimens at Dayton, and still greater numbers in possession of Dr. Hoy at Racine. From him I learn that while the common raspberry of the garden is in flower that it is a common resort of this insect, and it is probable the larva feeds on the leaves of this shrub.

47. HESPERIA TITYRUS is abundant wherever the locust tree flourishes. The other species of Hesperia are equally common, though their habits are less known.

THE OCEAN—ITS ORIGIN AND PHENOMENA.

Synopsis of Prof. BRAINERD'S *Lecture before the Cleveland Academy of Natural Sciences.*

Mr. B. first noticed some of the theories respecting the original condition of our planet. The most plausible one, in his opinion, was that which presents the earth, in its original condition, before the formation of a solid crust, in a state of fusion, or incandescence from heat; that it had been shown by Sir Isaac Newton, and others, that a fluid mass, possessing the density of the earth, and having the same velocity of rotation upon its axis, would, according to the laws of gravity and motion, assume exactly the spheroidal figure that the earth is known to possess—that is, an equatorial diameter greater than the polar, by about twenty-six miles.

He said that facts in geology strongly corroborated this position. The central nucleus of the crust of the earth, is composed of igneous, unstratified rock, the evident result of the cooling of this molten mass of matter, of which the granite rock is composed.

The granite rock is of universal occurrence; there is no place on the surface of the globe, where it could not be found, by penetrating to a sufficient depth. This was not true of any other form of rock entering into the formation of the crust of the earth.

As a further evidence of the igneous character of the granite, it was stated that a piece of granite rock might be placed in a crucible, and subjected to a degree of heat sufficient to render it fluid, and then suffered to cool under pressure, that its texture and general appearance would in no way be changed—it would still be granite, and possess all the characteristics of that rock. This could not be said of any of the stratified rocks; their whole structure and appearance would be entirely changed.

The legitimate inference to be drawn from this fact, he considered to be, that there was a time in the history of our planet, that no other rock existed but the granite, and that this was in a state of fusion, or in a liquid state, from heat, like melted iron.

This position is further shown from the present condition of our globe.

By the most careful investigations by Humboldt, and other eminent men, it has been ascertained that there is a line of equal and unvarying temperature, (49°F.) in all parts of the earth's crust, from the equator to the poles, ranging in depth from sixty feet to one hundred feet below the surface, which temperature remains constant, neither increasing nor diminishing, from which fact it is inferred, that there is no further *decrease* of temperature, from radiation—nor *increase*, from the influence of the solar rays.

If we pass below this line of unvarying temperature, an increase of heat is everywhere observed, amounting to about one degree of *Fah.* for every forty-five feet descent—and which, at this ratio, would reach the boiling point of water at about fourteen thousand feet; and at a depth of about thirty-four miles, a degree of heat sufficient to melt the most refractory substances known upon the surface of this planet.

The conclusions naturally drawn from these facts, and many others, of a similar character, which might be cited, is, that the earth, in cooling from a state of fusion, would present a very rough and broken surface of granite, and which would, for many thousand years, possess a temperature above the boiling point of water; and, consequently, there would be no decomposing agencies such as now exist, to reduce the immense elevation of the primitive granite mountains, or to fill up the vallies, with the accumulating detritus.

The surface of the moon, at the present time, presents an appearance similar to what is supposed to have existed upon the earth, previous to the formation of the Ocean.

These vast inequalities in the surface of the globe, at first contained no water.

But how were they filled? How was the Ocean formed? He did not agree with the published theories, that the Ocean was created a homogeneous mass of salt water. This view, he considered, was not in accordance with the operations of Nature, in other departments, where her creative energies were called into action by the great architect of the universe.

According to this view, how, then, was thr Ocean formed? The elements of which water is composed, certainly must have existed at this

epoch, either in their simplest forms, as Hydrogen and Oxygen; or in the condition of steam or vapor—which, in the latter case, would have surrounded the earth with a dense cloud, excluding even the light of the sun.

This, he believed, was the true state of the case. The continual condensation of this aqueous vapor, would cause an incessant fall of rain upon the heated surface of the granite rock. Decomposition would ensue, and the saline properties of the rocks would be held in solution in the accumulating waters.

Pure water, that which is formed by the condensation of vapor or steam, is eminently neutral in its qualities; it is neither saline, alkaline, or acid—but is, nevertheless, the most universal and powerful solvent known.

Rain water, when unimpregnated with gasses from the atmosphere, is of the purest quality; and had it not been for its powerful solvent properties, the waters of the Primitive Ocean would have been as pure as the purest spring, that flows from its pebbly fountain.

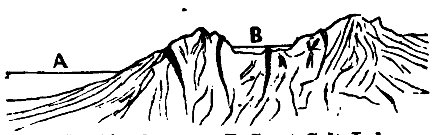
Mr. B. here alluded to the quantity of water that had accumulated upon the earth, covering, as it does, nearly three-fourths of its surface—and, if spread equally over the whole, would form a universal ocean, not less than three thousand feet in depth.

In this connection, the inequalities of surface, both of the continents and bed of the Ocean, were noticed, and the effect that evaporation has upon the saline properties of the waters of several inland seas and lakes.

It has been ascertained that the surface of water in the Dead Sea, was more than *one thousand three hundred feet* below the level of the Atlantic. Mr. B. stated that the cause of this difference was due to an excess of evaporation, and, as a natural consequence, these waters had become very highly charged with saline matter, containing about 26 per cent.—whereas, the waters of the Atlantic contain only about 4 per cent.

Should the annual fall of rain, in that region, exceed the evaporation, the area of the Dead Sea would be continually increased, and the saltness of the water decreased, until finally they would become fresh, and cover the whole of the country now below the Atlantic surface.

He stated that another example of a similar character was found in our own country, in the case of the great Salt Lake. This extensive body of water, is elevated about twelve hundred feet above the Pacific—surrounded on all sides by primitive mountains and having no outlet or communication with the Ocean. It is fed by numerous streams from the surrounding mountainous country, and still the waters, in the dry season, contain saline properties, even to saturation, and is the strongest salt water known upon the globe. The cause of this, is the excess of evaporation.



A Pacific Ocean: *B* Great Salt Lake.

The accompanying diagram shows the relative situation of the great Salt Lake with the surrounding country:

(CONCLUDED IN THE NEXT NUMBER.)

NOTE ON THE VEGETATION OF THE DRIFT.

BY J S. NEWBERRY, M. D.

Read before the Cleveland Academy of Natural Sciences.

The fact mentioned in the following interesting letter of Mr. Miller, is but one of many instances which have come to my knowledge, of the discovery of vegetable matter in the Drift.

In the excavations which have been made for the marine hospital, and for other purposes, in this city, and in wells dug in different parts of Northern Ohio, fragments of wood, of greater or less size, have been frequently brought to light.

Of these fragments, such as have come under my observation, have been nearly all of one character, being rolled and broken pieces of the trunks of trees of moderate dimensions, and which uniformly exhibit, under the microscope, the structure of the wood of the *Coniferae*.

Occasionally, the entire trunk has been found, as in the case mentioned by Mr. Miller; but, in these cases, the branches and roots are always broken off, the trunk nearly or quite denuded of bark, and its whole appearance showing that the tree has been uprooted from its place of growth, and borne along by a current of water, associated with other hard substances, by which it was for a long time triturated and worn.

The most interesting of these remains of the Drift Vegetation, which I have seen, was presented to me by Col. Charles Whittlesey, who has so carefully studied the phenomena of the Drift, in the Western States.

This is a *cone*, in which the general appearance, and internal structure are well preserved, and distinctly visible.

It was obtained from a Drift deposite, some 35 feet below the surface, near the mouth of Yellow Creek, Columbiana Co., Ohio, (not far from the locality mentioned by Mr. Miller) where it was associated with a large quantity of vegetable remains, and with the jaw of an extinct tapiroid animal.

This cone is cylindrical, about four inches long, and evidently once belonged to a species of *Abies*—indeed, it closely resembles the cone of the Balsam Fir—*A. balsamea*—which now grows nowhere spontaneously in Ohio; being emphatically a northern plant

But I do not propose now to give a detailed description of the facts or specimens which I have collected, relating to the vegetation of the Drift period. At another time I shall hope to do this—but, at present, would only call the attention of collectors to the interest which attaches itself to these specimens, specimens which, if carefully preserved and properly studied, will probably greatly aid us in giving a satisfactory solution of the troublesome problem—of the deposition of the Drift; for although the mineral materials of the Drift may, in many instances, indicate the character of the *rocky basis* of the country swept by the Drift current, of its plants and animals, and hence of its topography and climate, we have, up to the present time, but the most limited knowledge.

My observations have led me to regard the accumulations of Drift materials, in circumstances similar to that described by Mr. Miller, to a Neptunian rather than a Plutonic agency.

I have regarded them as collections of transported material—often transported from immense distances—which, swept along the ocean bottom, found appropriate resting places in the ravines and excavations made, either by the Drift current itself, or by ancient water-courses; as I have failed to find satisfactory evidence of Plutonic disturbances of the coal strata of Ohio, in any localities which I have examined, except in a few rare instances, where the disturbances are very slight. Our vallies are almost universally vallies of denudation, and our ravines and gorges—perhaps without exception due to the action of water. These erosions of the rocky strata are not unfrequently met with in the exploitation of coal mines, probably for the double reason, that the coal, at its outcrop would, from its softness, be so readily excavated by running water, and we penetrate and explore the sub-stratum of this region, almost for nothing else than coal.

Extract of a Letter read before the Cleveland Academy of Natural Sciences.

"A circumstance occurred in our neighborhood, about a month since, that called my attention particularly, and I have presumed to trouble thee with it.

"In opening a coal bank in this vicinity, the operator came to an abrupt terminus of the coal. Clay, coarse sand, and fragments of sand stone edgewise, and in every position; some sticks, and what appeared to be sections of grape vines, till finally about four feet from the coal, a Spruce-pine log was laid bare, lying horizontally about midway between the top and bottom of the coal, and at right angles with the advance. It was about nine inches in diameter, and appeared to have been water-worn; its branches were a little projecting, but had been broken off before deposited in this, its long resting place. The coal was found again about ten feet from where it terminated.

"No timber is now found of that kind in less than five miles of the place, and then in very dissimilar situations.

"The great question is, How came the pine log in that situation? I gave my friend C. Whittlesey, a more particular description, with the topography of the ground, and its locality in relation to the drift district, and requested him to give his views, if so disposed, and direct them to thee, and I would do the same with mine.

"My conclusions are, that it could not have been placed there by any other circumstance, than that of a chasm having been opened by an earthquake, and the log; with other materials, fallen in. The nature of the ground precludes the probability that a slip or land slide could have occurred—and to strengthen my position, this locality is in the immediate vicinity of the southern limit of the drift district, which leaves the marks of having been an ancient sea-coast, which has been ruptured, in all probability, by earthquakes. I have found in those capacious water gaps the dislocation of strata, and separation of rocks, that could not have been effected by any other now known cause.

"Another circumstance: in the bluffs adjoining those water gaps, the coal is rarely worth mining, having been pulverized and exposed to the water from above it; hence, our best coal is generally obtained up small streams that are more retired from these apparent scenes of disturbance.

"I have, in my cabinet, preserved good specimens of the piece, that can be seen at any time—or, if any one wishes, I could send them some, by being informed where to direct them.

"Very respectfully thine,

"MORRIS MILLER."

Hanover, Col. Co., O.

ANALYSES OF OHIO COALS.

BY DR. J. S. NEWBERRY.

Read before the Cleveland Academy of Natural Sciences.

No. 1.—*Mahoning Valley Coal.*

Remarkably compact, coming from the mine in large tabular masses. Color, dull bluish black in the mass; freshly broken surface of

a brilliant resinous lustre—fracture, splintery and rough. Specific gravity, 1.2695.

Chemical composition—	Carbon	61.244
	Bitumen	35.966
	Ashes	2.790
	Total	100.000

Economical Value.—This coal is unequaled in its adaptation to the manufacture of metals, and is successfully employed in the raw state to the reduction of ores by the hot blast.

Geological position—Lowest bed in the Ohio coal field, 50 to 75 feet above Conglomerate.

Specimens examined, from Youngstown and Mount Nebo, Mahoning county. Thickness, 4 to 5 feet.

No. 2.—*Tallmadge Coal.*

Softer than preceding variety,—breaking into cubical fragments. Color, brilliant black, with some scales of silex and spangles of sulphuret of iron in the joints. Specific gravity, 1.264.

Chemical composition—	Carbon	53.727
	Bitumen	43.713
	Ashes	2.560
	Total	100.000

Economical Value.—Adapted to the generation of steam, for household use, and the production of gas. Extensively used, when coked, for the reduction and manufacture of metals.

Specimens taken from Upson's, Harris's and Newberry's mines, in Tallmadge, Summit Co.

Geological position, same as last.

Thickness, 4 to 5 feet.

No. 3.—*Chippeway Coal.*

Hardly to be distinguished in external character from the last, but more uniform in quality. Specific gravity, 1.265.

Chemical composition—	Carbon	56.050
	Bitumen	40.890
	Ashes	3.060
	Total	100.000

Economical value, geological position, and thickness, same as last.

From Clinton, Stark county.

No. 4.—*Bolivar Coal.*

A bright, handsome variety, of a brilliant black, vitreous lustre, and cubical, sometimes conchoidal fracture. Hardness medium. Resembles best specimens of Chippeway and Tallmadge, but a little softer and more bituminous. Specific gravity, 1.283.

Chemical composition—	Carbon	47.494
	Bitumen	49.776
	Ashes	2.730
	Total	100.000

Economical value, same as Tallmadge and Chippeway. From its highly bituminous character, it forms a peculiarly pleasant and cheerful fire in a grate; and with a careful exclusion of the sulphuret of iron which it contains collected in easily separable masses, it would form a superior gas coal. The stratum from which it is derived is the third in the ascending series from the base of the productive coal measures.

From Dickinson's mine, Sandyville, on Sandy and Beaver Canal.

Thickness, 4 feet.

No. 5.—*Fairview Coal.*

Resembles the Mahoning Valley Coal in structure and purity, but softer and more brilliant, and having rarely scales of silex and sulphuret of iron in the joints. Specific gravity, 1.267.

Chemical composition—	Carbon	57.341
	Bitumen	40.890
	Ashes	1.769
	Total	100.000

Economical Value.—A remarkably pure coal, and evidently well adapted to the manufacture of metals, as well as all other purposes for which mineral fuel is required.

Geological position, same as Chippeway and Tallmadge.

From mine of Tod and Rhodes, Baughman township, Wayne county.

REVISION OF THE SPECIES BELONGING TO THE GENUS ESOX, INHABITING LAKE ERIE AND THE RIVER OHIO.

BY PROF. J. P. KIRTLAND.

Read before the Cleveland Academy of Natural Sciences.

Much confusion prevails in regard to the species of this genus inhabiting the waters of the State of Ohio. As a portion of it has occurred from some of my publications it seems appropriate that I should attempt its correction.

Girard has divided this genus into two groups, which he thinks are distinguished by organic differences.

a. PIKES.—*Cheeks and opercular appendages smooth.*

b. PICKERELS.—*Cheeks and opercular appendages scaly.*

Our species at present definitely recognized are the following to wit:

I. Esox Nobilis.—Thompson.
Thompson's Appendix to History of Vermont.
E. atro-maculata, Kirt. MSS.
E. estor, Kirt. description and figure, vol. v.
Boston Jour. Nat. Science.
Muskallonge of the Fishermen.

II. Esox Estor.—Le Sueur.
Le Sueur. Jour. Acad. Nat. Science Phil., Vol. I.
E. reticulatus, Kirt. Boston Jour., Vol. IV., figure and description.
Muskallonge, Le Sueur and DeKay.
Pike of the Fishermen.

I was led into a misapprehension in regard to the species intended to be embraced by Le-Sueur under his name *Estor*, from his having applied to it the common name "*Maskallonge*," which no one else except Dr. DeKay ever employed in that connection. The *E. nobilis is the Muskallonge* and the E. Estor *the Pike* of our fishermen.

Having solved the mystery in reference to to these points, and finding that Le Sueur's *E. reticulatus* was not an inhabitant of our waters, I prepared a description of the first named, under the specific appellation of "*atro-maculatus*", but subsequently learned that I had been anticipated by the Rev. Z. Thompson.

III. Esox Umbrosus.—Kirtland.

Form—oval-elliptical in its general contour.

Head—obtuse.

Upper Jaw—slightly concave between the tip and forehead.

Lower Jaw the longer, and prominent.

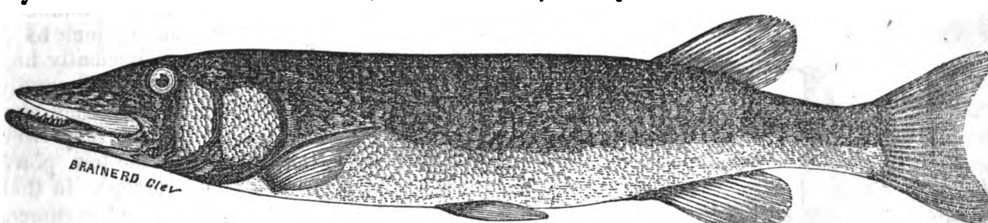
Body—sub-cylindrical, slightly compressed on the sides, and full on the back.

Fins—especially the caudal short.

Color—Upper surface of the head brownish green, interspersed with lighter shades; sides of the body, lower jaw and gill covers, of a whitish ground color, shaded with slight brown; fins dusky white, the caudal clouded with brown.

Length—total $11\frac{1}{4}$ in.; head $2\frac{1}{8}$

Branchial rays 12, D. 13, P. 13, A. 12, V. 12, C. $18\frac{6}{5}$.



Observations.—This small species rarely attains a greater length than the specimen before us, which was taken in a small bayou of Rocky River, in Rockport. It belongs to Girard's group "*Pickerels*" of the esoccidæ, the operculum and preoperculum being thickly set with minute scales. The short head and caudal fin readily distinguish it from the young of the larger species. From DeKay's E. fasciata it differs in having no bands on its sides, as well as in the number of rays in the several fins. Like the E. estor it has a black vertical band extending from the pupil of the eye to the side of the lower jaw. The three preceding species inhabit Lake Erie, and some of its tributaries.

IV. Esox Ohioensis.—Kirtland.

From a very perfect stucco cast and a dessicated head of a specimen taken in the Mahoning, a tributary of the Ohio river, it is evident that this species is distinct from any of the preceding. Its contour is more regular oval and elliptical than that of the *E. estor* and less regular than that of the *E. nobilis*. The head is rather small, fusiform and attenuated, and its vertical measurement through the eye proportionably less than in any other species; caudal fin emarginate and falcate more acutely than of the Estor. The color of the back, greenish brown; sides, lighter, but shaded with brown; underneath, white.

Total length 30 inches; head $7\frac{1}{2}$; vertical line through the eye, from frontal surface to bottom of lower jaw $2\frac{3}{8}$ inches. This species sometimes attains $31\frac{1}{4}$ pounds weight.

THE MICROSCOPE AND MICROSCOPIC MANIPULATION.

BY H. L. SMITH.

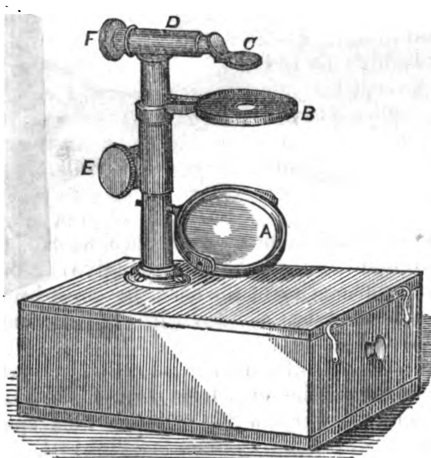
No. II.

I shall suppose the reader of these articles already familiar with the ordinary terms employed in optics, and to understand what is meant by a plane-convex lens, double convex, focal lengths, &c.; if they do not, any elementary work on Natural Philosophy will furnish the desired information.

Microscopes* are usually classed into simple and compound. The distinction is a verbal one, for many of the better simple microscopes are

compound in reality. The real difference consists in this, that with a simple microscope, we view at once the object itself; with a compound, we observe its image. The term simple microscope, therefore, includes all single lenses, or combinations of them, in the form of doublets or triplets, with which we view an object directly; while the term compound microscope, embraces the various forms which are furnished with an object glass, whether this glass be achromatic or not.

Now, as the type of a cheap simple microscope, (for the description of one will serve for all) I shall select Raspial's convenient form, for various reasons; the principal one, however, is, that as I am writing these articles for practical use, it is necessary to describe such instruments and accessories as far as possible, as can be readily obtained; and, therefore, notwithstanding Dr. Goadby's opinion, and not having the fear of "high authority" before my eyes, I venture to suggest, that the little instrument now to be described, will be found an exceedingly useful table microscope. The forms of doublets, and the construction of eye-pieces, achromatic objectives, &c., will be found in another place.



Raspail's Simple Microscope.

This little instrument consists of a simple, upright pillar, about half an inch diameter, and five inches high, which screws into a piece of brass, inlaid upon the top of a neat little box, which will contain the whole instrument, and the various appurtenances belonging to it.

The adjustment of focus is effected in two ways: first, by the movement of the stage plate B, by means of a milled head and rack-work, or by sliding the piece D up or down, as may be required. A combination of both movements enables one to use upon the same instrument lenses from two inches focal length, to anything less than this.

The magnifiers, which, in the instrument as commonly sold, are double convex, are set in a blackened brass cap, which slips, or screws into a ring B; by turning the piece C, a lateral movement, or traverse, across the field or stage plate is effected, and a movement at right angles to this, is obtained by means of the milled head D. The stage B, consists of a large blackened brass ring, which may be easily removed for the purpose of packing; into this ring a piece of thick glass, nearly two inches diameter, is fitted, and serves as a support to various objects which it may be necessary to examine; and from the facility with which it may be removed and cleaned, is an invaluable appendage. Beneath this glass is usually placed a blackened brass plate, having a hole in the middle, about half an inch diameter, which bounds the field of view, and serves to assist the manipulater, in locating an object in the proper position upon a glass slip, for a permanent preparation. Beneath the stage is placed the plane mirror A, which may be turned in any proper position, to reflect the light through the object, upon the stage plate.

As to the lenses generally furnished with this instrument, they are four in number—double convexes, ranging from $1\frac{1}{2}$ inch to $\frac{1}{15}$ inch focus, the latter being a sufficiently high power to exhibit the blood globules easily. These lenses would be much better if they were plano-convex; and still better, if they were achromatic. I usually employ the low power objectives of a compound microscope, in their place, when manipulating with this instrument. It always stands upon my working table, and is ready to serve either for minute dissections, or for arranging an object properly upon a slide, previous to mounting it. The lower powers will be found most generally useful, from one inch to one-half inch focus. Although the lenses furnished by the Parisian opticians with the microscope, are double convexes only, yet they will serve a very good purpose, where one has not the means to supply better—as, usually furnished, one does not get the full benefit of their penetrating power from the unnecessary contraction of the aperture in the brass setting. This aperture should be just as large as is consistent with good definition, and for the highest power, will probably be not far from right as furnished by the maker; the others, however, will generally bear enlarging. The lowest power, or longest focus glass, permits the largest opening, and as the settings of the glasses may be unscrewed from one cap, and put on to another, one may judge by thus adapting the setting of a higher power to the cap of the lower, whether it will answer to enlarge the opening of its own cap. Generally, some advantage may thus be gained, but if

once too much aperture is given, the definition will be seriously impaired. The opening to the highest power ($\frac{1}{10}$ of an inch) should just admit a fine cambric needle, No. 6, to pass through. That of the two inch lens may be $\frac{1}{4}$ of an inch. With a small aperture, the outlines of transparent objects will be more sharply defined than with the larger opening; but many delicate lines and markings will be lost. It is so easy, however, to make the high simple magnifiers, particularly the Wollaston doublets, and which I feel confident any one may make, who will carefully try, according to the directions I shall give, that the young microscopist, who can only afford a few dollars, may have the pleasure of seeing with this little instrument, a great majority of those wonderful objects which are in the minute world. No view of these objects can of course equal that afforded by a fine achromatic; but I too well remember the pleasure I experienced in my early days of microscopy, in observing, through my own lenses, adapted to a "Raspail," to forget there are yet many others who would gladly have the same pleasure. Indeed, the microscopist must be a sort of ingenious mechanic himself, in the small way, if he would succeed; for there are so many little, delicate operations to be performed, that he will be in a sad case, if obliged to trust to ordinary workmen. Even to sharpen well a little knife, or finish a fine point, will be found not by any means an easy task. With the Raspail instrument, briefly described above, is furnished a small knife, and two needles, in handles, good for certain purposes, but, of course, cheaply made. The brass work is generally very good; if the movements should be stiff, the ingenious manipulator will soon detect the difficulty, and easily remove it—as a lubricating material for the screws, &c., tallow will be found far better than oil. And now, as it would be of but little use to describe either the instruments or the materials, used in microscopy, unless one could readily purchase them, I shall, in all cases, give this information, when possible. The "Raspail" may be purchased for eight dollars, of Messrs. Emmerich and Gr. Vila, importers, John street, New York; and probably for the same price, of McAllister & Co., 48 Chestnut street, Philadelphia. Doubtless other opticians sell it equally cheap.

[TO BE CONTINUED.]

CASE OF POLYDIPSIA OR EXCESSIVE THIRST.

To the Editor of the Boston Medical and Surgical Journal:

DEAR SIR:—I have noticed in several of the public papers, from time to time, accounts of the case of James Webb, the water drinker, and I think in your Journal also. When I was a student of medicine, I heard of Webb, paid him a visit, and published in the New England Medical Journal for July, 1815, some history of him. It might be interesting to re-publish this, since it will bring together the facts of the case which has thus existed for a period of about sixty years.

I send you the volume of the Journal containing the account, which you can make use of, if you think proper. I am very truly yours,

JOHN WARE.

Boston, Nov. 30, 1853.

The subject of the following account is a young man, named James Webb, now living in the town of Hingham, in this State. Having been informed of his singular case, I went in company with Mr. Norton, Librarian of Harvard University, to ascertain its nature, and the truth of the circumstances related concerning him. During our visit, the following facts were collected from his own account of himself which were confirmed by the testimony of the persons with whom he now lives, and, as will be presently stated, more particularly by that of others with whom he has formerly lived.

He was about 20 years of age some time in the month of October, 1814. His appearance is that of firm health; his complexion is dark and ruddy; he is short, thick, rather sturdy, and, except his preternatural thirst, has never been afflicted with disease. At present, the quantity which he habitually drinks in twenty-four hours, amounts to three pailfuls, or six gallons. This is necessary, not only to prevent the sensation of a tormenting thirst, but to preserve him in his ordinary state of health; for when he abstains from his usual allowance, his head is affected, and he becomes dizzy, weak and sick; or, as he himself expressed it—"When I don't drink, it gets into my head." He finds himself obliged to drink at intervals of about an hour and a half or two hours, one or two quarts at a time. At night he places a pailful of water at his bedside, the whole of which he requires before morning, waking whenever it becomes necessary. He has sometimes taken to the amount of a gallon at once, without experiencing any bad effects. He drank two quarts in our presence, having taken one but fifteen minutes before. He swallows with great eagerness and the appearance of satisfaction, drinking a quart in the time that a common person would one-quarter of that quantity. He uses water directly from the well even in the depth of winter, and avoids mixing anything with it, especially any kind of spirituous liquors, which he dislikes. Its coldness causes no inconvenience, except occasionally a slight chill. He has no recollection of the time when this habit commenced, but has been told

by his parents that it was in infancy and soon after birth. The quantity which he now drinks does not, he thinks, differ materially from that which he drank at 9 or 10 years old. He has several times endeavored to break off the habit, but has always suffered in the attempt in the manner above mentioned. His appetite for food is not remarkable; the person with whom he lives merely observing, that he was a hearty eater. His meat and drink at meals are like those of the persons with whom he lives. His pulse, during our visit, was full, strong, and remarkably infrequent, not exceeding at any time 56 pulsations in a minute, and being sometimes so few as 45. It varied as follows:

Some time after drinking, 56.

Fifteen minutes after drinking, and just before drinking again, 50.

Immediately after drinking two quarts, 45.

The temperature of the atmosphere has no influence on his thirst, since he requires the same quantity of water in the warmest as in the coldest weather. He had an uncle who was formerly affected in the same way, though not to an equal degree. He served in the army during the revolutionary war, and was said to have died in consequence of being in a position where water was not to be obtained.

As would be supposed, these extraordinary quantities of fluid are wholly carried off by the kidneys, and affects the secretion of no other part. His urine he thinks equal in quantity to the whole of the water which he drinks. The qualities of the secreted fluid I had no opportunity of examining. He perspires very little, and his fæces are of the usual healthy consistence.

This account is confirmed by Messrs. Wilder and Hersey, two persons with whom he formerly resided. With Mr. Wilder he lived some time at about the age of 9 or 10 years, and his relation agrees with that of Webb in every particular, especially as to the quantity of water drank during twenty-four hours.

With Mr. Hersey, Webb lived from 14 to 18 years of age. He thinks that the quantity increased while he was with him, and feels confident, that during the latter part of the time he drank as much as four pailfuls or eight gallons daily, and has known him to drink a gallon at a time. He never knew him to suffer from want of water but once, when away from home where none was to be obtained; he looked pale and said he could not live ten minutes longer, but was immediately relieved by drinking. He used to shudder from ten to fifteen minutes after drinking, so that his teeth would chatter. His health and appetite were good. He used no spirit. Mr. Hersey says that he has understood from the person with whom he lives now, that the quantity has diminished since Webb has been with him.

In the second and third volumes of A Collection of Medical Facts, published in London in 1792, are accounts of three cases similar to that above detailed, of which, for the sake of comparison, it may be worth while to subjoin a short notice. The first was that of Catharin Bousergent, a French woman, forty years of age. The disease had existed from infancy. When single, she drank three pailfuls daily; but after marriage, when pregnant, only two. The quantity was stated by others to be sometimes four pailfuls.

The second case was that of a man in England, aged 51. The disease had existed twenty-three years, and came on after a long-continued fever and ague. The quantity he drank amounted to sixteen or seventeen quarts daily.

The third subject was a boy of five years; his pulse from 80 to 85. His daily quantity amounted to about ten quarts.

WHAT IS COAL?

The Torbane Hill coal estate, in Linlithgowshire, will long be intimately connected with this question. The actual details of the extraordinary trial, of which it was the cause, are, in themselves, a remarkable object for comment, quite as peculiar indeed, as the primary question leading to the contest. The plaintiffs in the case were the Messrs. Russell, coalmasters, of Falkirk; and the defendants were Mr. W. Gillespie—the inventor of the "Inclinometer," illustrated in our July part—and his wife, as heiress of the estate. The record showed that by a contract for a lease, entered into in 1850, it was agreed that the plaintiffs should grant to the defendants a lease of "the whole coal, ironstone, iron ore, limestone, and fire-clay, but not to comprehend copper or other minerals" in the estate, for a period of twenty-five years, at certain royalties for the first year, and £300 a year or the royalties, at the option of the plaintiffs, every year afterwards. The defendants were, of course, to incur all the working expenses; no fixed rent being exigible for the first year, for which period the royalties on the produce actually raised should alone be paid. But when coal or iron was found in a profitably workable condition, a formal lease was to be entered into. On this the defendants entered, and are still in possession; but no formal lease has, so far, been executed. The allegations of the plaintiff were to the effect, that although coal, ironstone and clay had been met with in a workable condition, the defendants had confined their operations to the working of an argillaceous bituminous mineral, which had not been let to them, and formed no part of the

agreement. Prior to the date of the action, 19,000 tons, of 22 1-2 cwts. to the ton, of such mineral had been so raised and disposed of as "gas coal." But the substance in question was of far greater value than ordinary coal, or any other of the minerals specified in the agreement; nor could it be classed as coal, its chemical and mineralogical constitution and qualities being essentially unlike those of common coal. That prior to the agreement no such substance was known, and, therefore, that the plaintiffs could not have let a mineral of which they had no cognisance. For the defendants, it was alledged that they had entered upon the land with a view of finding what is known as "Boghead coal," believing that the Torbane Hill strata were the same as on the adjoining Boghead estate. That the mineral which they had met with and raised was really of a class similar to Boghead mineral, and, consequently, that they had only raised what they had covenanted to pay for. The important question then was whether the mineral in dispute was or was not coal. For the plaintiffs, Messrs. Austen, Anderson, Brande, Rose, Dr. Anderson, Wilson, Cooper, and others, were examined as scientific evidence. For the defendants, Messrs. Johnson, Ramsay, Hoffman, Fyfe, Maclagan, Gregory, Frankland, Dickinson, and others, appeared. It was this evidence which gave so peculiar a color to the proceedings. We never read anything so utterly conflicting as the analyses and details which formed the cross-fire between the two bands of witnesses. After their respective statements had been heard, and after the addresses of the counsel on both sides, the Lord President summed up—if an attempted digest of irreconcileable statements can be called a summing up—saying that the Jury were to determine whether the substance in question fell within the term whole coal in the demise, for it was not pretended that it came within any other terms specified in it. On the one side there were four geologists, who gave it as their opinion that it was not coal, and five on the other side who said it was coal, all speaking with perfect sincerity, according to what they, as geologists, classed as coal. Men of the highest reputation in geology and chemistry had been examined, but they differed very much in opinion. On one side there were five of the most eminent chemists, who had applied all their skill and energy to find out whether it was coal or not, and who had expressed themselves as of opinion that it was not coal, while ten, equally eminent, on the other side, were of a diametrically opposite opinion. Is this substance, then, a coal or not, in the ordinary language of those who deal in it, and of the country? because, to find a scientific definition of it, after what has been brought to light within the last five days, would be, he said, indeed a very difficult thing. In five minutes the jury returned a verdict for the defendants, thus establishing that, in their opinion, the mineral was really coal. That this was a just and honest verdict, we fully and entirely believe. It appears to us that the Torbane mineral is simply a more gaseous kind of cannel than we are accustomed to meet with. No doubt it possesses other minor peculiarities, but none that are not reconcilable with the assumption that the stratum is simply coal in a transitionary state. The most that can reasonably be said is, that a peculiar and unlooked-for hardship is entailed upon the unlucky proprietor, who is receiving a few pence per ton as royalty upon what sells in the market at something like four times the price of common coal, paying a similar low royalty. But this may be the fate of any speculation, and it seems a pity to have pursued so desperate a course as the attempted proof that the mineral was not coal. But what are we to think of the unqualified contradictions of the leading men who furnished the scientific evidence? Does that chapter of the trial's history read like a hint that mere labratory experimentalists are of little avail in industrial practice; that theories are the night soap-bubbles with which the grown-up children of science amuse themselves, or does it suggest something worse?—*Practical Mechanic's Journal.*

ON A NEW METHOD OF DETERMINING THE QUANTITY OF UREA IN THE URINE.

BY JOHN W. DRAPER, M. D., PROFESSOR OF CHEMISTRY AND PHYSIOLOGY IN THE UNIVERSITY OF NEW YORK.

Much attention has of late been paid to the methods of determining the composition of the urine, it being very generally acknowledged, that if we possessed the means of a quick and accurate analysis of it, we should be able to settle many contested questions, both in physiology and pathology.

Among the constituents of the urine, the nitrogenized bodies, urea and uric acid, are perhaps of the greatest interest, for they represent the waste which has taken place in the soft tissues generally. Accordingly, from time to time new processes have been published for the estimation of these bodies, and more particularly the first—urea. The methods recommended in the works on animal chemistry and organic analysis are, however, very far from satisfactory. Thus Simon, in his *Chemistry of Man*, effects the determination of the quantity of urea by forming the sparingly soluble nitrate, and Bowman, in his Medical Chemistry, resorts to the acetate, but both of these are very tedious and very disagreeable operations, and what is

worse, uncertain in their results. Liebig has recently recommended the ternitrate of mercury, but the preparation of the test liquids is troublesome, and since the estimate eventually depends on the production of a particular tint or shade of a yellow color, it cannot be exact.

There are, however, some simple methods which will give absolutely accurate results. These all depend on the principle, that urea and uric acid, when brought in contact with nitrous acid, undergo immediate decomposition with a brisk effervescence, owing to the escape of carbonic acid and nitrogen gas.

The quantity of these nitrogenized principles in the urine may be ascertained by determining the quantity of carbonic acid or of nitrogen thus set free, during the destructive decomposition of urea and uric acid by nitrous acid. Forty-four parts of carbonic acid, or twenty-eight of nitrogen, answer to sixty of urea.

One of these methods, which is extremely exact, I have recently described in the London and Edinburgh Philosophical Magazine. It is to conduct the disengaged carbonic acid into water of barytes, and weigh the resulting carbonate of barytes.

I have also, in examinations which I am constantly making of the urine, frequently resorted to the other plan of estimating the urea, from the quantity of nitrogen set free; and this I have done in two different ways: 1st, by determining the quantity of nitrogen by weight; or 2nd, by volume. The following is a more particular description of each of these.

A liquid suitable for the decomposition of urea is easily and economically prepared by taking a single cell of Groves' voltaic battery, and placing strong nitric acid in the porous cup, and otherwise charging the cell in the usual way. After a few minutes, the nitric acid turns green, becoming charged with nitrous acid. It is then to be decanted for use. If this liquid be poured into urine, filtered from its mucus, or into a solution of urea, a brisk effervescence sets in, and if a sufficient quantity of acid is used, so that red fumes are disengaged, the urea is totally decomposed, carbonic acid and nitrogen gasses escaping.

In the first of the preceding methods, viz: That of determining the urea from the weight of the nitrogen, a known weight of urine (2 grammes) filtered from mucus, is placed in a bottle containing a tube filled with the nitroso-nitric acid above described; from the bottle a bent tube conducts the escaping gasses through potash water, and then through a chloride of calcium tube. The operation is conducted in a manner well known in laboratories for the analysis of a carbonate, the loss of weight of the whole apparatus gives the quantity of nitrogen which has been set free. The operation requires about half an hour, and is quite exact.

In the second method, viz: That of determining the urea from the volume of the resulting nitrogen, the operation is essentially the same, only instead of letting the nitrogen escape into the air, it is received into a gasometer, and its quantity ascertained. As conducted in my laboratory, the amount of urea in a sample of urine may thus be determined in from ten to twelve minutes, and with certainty, to one thousandth part of the weight of the urine; a degree of exactness far beyond that of the old processes, and an expedition which at once recommends this method to physiologists and pathologists.—*Virginia Medical and Surgical Journal.*

ON THE POLARIZATION OF LIGHT BY REFRACTION THROUGH A METAL.

Biot found that two gold leaves are sufficient to polarize direct solar rays completely. Rollman has examined the subject anew, and has employed the gold leaves both as a polarizing and as an analyzing arrangement. When the light is very intense, only a single leaf can be employed, as otherwise the field of view appears too dark. When used as an analyzer, a gold leaf shows very distinctly the colors of thin plates sf gypsum, cooled glasses, &c., but these are naturally modified by the peculiar blue green color of the gold. If we allow plane polarized light to pass through an inclined gold leaf, and examine by a tourmaline in the light so transmitted a plate of calcspar cut perpendicular to the axis, we shall observe the phenomena of elliptic polarization, when the gold leaf and the analyzer are turned to an angle of forty-five degrees with the planes of polarization. The colored rings are narrower in the first and third quadrants than in the second and fourth, the cross is converted into two hyperbolas, whose branches do not meet. When in the above experiment, we leave every thing else unchanged, and examine the calcspar with the analyzer, by means of the light reflected from the gold leaf in the place of that transmitted, we observe the complementary figure such as we obtain it when we employ the transmitted light, and the tourmaline is turned through 90°. The tourmaline must be green in order to transmit the light well. Brewster's discovery of the elliptic polarization by metallic reflection is thus extended and completed.—*Pogg. Ann.*, xc, 188.

M. Elie de Beaumont has been elected Secretary of the Institute of France, in place of M. Arago, lately deceased. M. Dupin contested the honor with him.

☞ PLEASE READ. ☜

We beg leave to say to those who have received the first three number of Vol. 2d of the Annals, and who have not yet remitted us the subscription that on account of the great expense attending the publication of our paper, we shall be obliged to discontinue sending to all who do not remit to us the low price of subscription, at once. We have selected the names of those to whom the first three numbers were sent with great care, and hope they will all be willing to patronize our effort to publish a cheap scientific periodical. No numbers will be sent hereafter to those who do not comply with our terms as above stated. We prefer keeping them and binding them at the end of the year. The subscription can be remitted at our risk, if properly enclosed. Our constant aim will be to improve the Annals, but we can only do this with good heart by receiving in return a liberal supply of the "needful" from our patrons. Those who have already remitted us for Vol 2, wlil please find the receipt printed below.

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CONTENTS OF NO. III.

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BEING A

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ON THE STRUCTURE OF THE LIVER.

BY PROFESSOR KOLLIKER.

The second volume of the great work on microscopical anatomy* by the Professor of Wurtzburg, has recently been published. The writings of Dr. Kolliker are familiar to the student of histology, and his name is well known to the profession at large from his discovery of the involuntary muscular fibres of the urethra and prostate, and his researches into the intimate structure of muscular tissue. This part of the *microskopische anatomie* is devoted to the histology of the organs of digestion and respiration; these subjects occupy 900 pages, from which an idea may be formed of the comprehensive manner in which they are taken up. Each organ is successively and minutely described, the explanations being rendered clearer by 127 engravings on wood, most of them original. We should greatly transgress the limits to which the preference of the profession for (so called) practical matters restricts us, were we only to advert to the various subjects which are profoundly discussed in this admirable treatise; we therefore prefer giving an analysis of a fragment only, and in selecting the chapter on the structure of the liver, we are influenced by the consideration that while no subject in microscopical anatomy has given rise to more discussion than this, there is yet none upon which opinions are more widely at variance.

The most important observations upon the structure of the secretory parenchyma of the liver may be condensed as follows:

1. The structure of the liver is analogous to that of the glands, in the form of a bunch of grapes. Prochaska, and Muller after him, have admitted that the biliary ducts terminate like those of the pancreas and salivary glands, that is to say, by a sort of cul-de-sac. Krause, who, in 1837, maintained that the canaliculi ended in inflated extremities like little bladders, supported his opinion, in 1845, by new experiments. According to this author, who examined the uninjected liver, these expanded extremities are of a yellowish color, from the fortieth to the sixty-fifth of a line in diameter; they are placed in apposition, and contain a yellow liquid.

2. The portion of the liver which secretes the bile is a vascular network. Kiernan supposed that an anastamosis existed between the intimate glandular elements of the liver. Weber supported this doctrine by direct experiment —and most authors have since adopted it. As to the manner in which this net-work is composed, it is admitted: *a.* that it is formed by true canals, with a pervious passage and wall, which result from the fusion of the hepatic cells; *b.* that these canals are situated between the cells of the liver. According to this last hypothesis, the canals are tubes provided with a structureless membrane which envelopes the cells of the liver (Schoeder Van der Kolk, Backer and Retzius) or they are simply intercellular spaces (Gerlach, Natalis Guillot.) *c.* It is possible that the net-work of the hepatic cells is solid, without other cavities than those of the cells themselves. In this case, the finest ramifications of the biliary vessels do not penetrate into the lobules, but terminate in a cul-de-sac upon their external surface.

3. The secretory parenchyma of the liver is formed by interlaced canaliculi in the form of trellis-work, without terminations, and without anastomoses (Arnold).

Before discussing the value of these opinions —which it suffices to bring together, in order to show their diversity, let us see what results from microscopical observation. Each hepatic lobule contains two elements: 1. A net-work of capillaries, continuous, on the one hand, with the ultimate ramifications of the portal veins, and opening, on the other, into the central vein of the lobule, which, as is well known, is one of the origins of the hepatic vein; 2, a plexus of partitions, formed exclusively by the juxtaposed cells. These two plexuses are so closely united, that the voids in one are completely filled by the other, so that no unoccupied space is left. In this net-work there is not the slightest trace of biliary vessels; it is only at the periphery that they are perceived; it is in the same way on the exterior alone that the smallest ramifications of the venæ portæ are found. It has hitherto been impossible to determine the exact relations of these two or-

* *Microskopische Anatomie oder Gewebelehre des Menschen;* von Dr. A. Kolliker. Zweiter Band: Leipzig: 1852.

tives, when the amplification is the excessive one of 2000 diameters. So, also, we may examine, as an opaque object, a scale of a fish, a wing of a moth, a feather, a leaf, or a petal, by diffused daylight, without Lieberkuhn or other condensing apparatus, and, under a low magnifying power, we shall perceive, not only more clearly than with a hand lens, but also more plainly than with the naked eye, those coarser details which need either no amplification or but a slight one. The instrument has the same effect as if it not only magnified, but illuminated the object, and with a light surprisingly clear, uniform, and pleasant. It is not useless to mention such facts, for there are probably many who do not know, and little suspect the perfection of the best instruments as now made, and their superiority not only in pleasantness, but trustworthiness over the single microscope.

Large aperture being so important, it has become customary simply to mention its extent in commending an objective. Dr. Goring seldom mentioned the magnifying power of an object glass needed for a particular test; but in regard to the tests now most used, which require to be magnified so much more, no accurate account can be given except such as specifies the degrees of the two qualities, aperture and magnifying power, which are needed for their resolution. Indeed, expansion and definition sufficient for counting with a micrometer, is the only standard which can enable one investigator to compare his observations with those of another.

Of late, the superior correction which opticians can accomplish on medium powers, makes them more efficient than higher ones even on tests for which the greater expansion of image of the latter is an important advantage. A smaller angle now will often accomplish more than one larger by a half. The anticipation of Mr. Pritchard,* that large apertures by permitting a longer conjugate focus, may ultimately enable all organized structure to be investigated with $\frac{1}{4}$ inch glasses, has been fulfilled sooner than he probably could have anticipated. Objectives of this grade now resolve every known test.

Of the two unavoidable remainders of error, the spherical becomes the most important for farther reduction; we thus gain not only in what is called definition, that is fineness and delicacy of lines, but in light and shade, in depth, and even in light. Take a $\frac{1}{4}$-inch object glass of very fine definition, but an aperture no larger than reported by Mr. Quekett (between 60° and 70°) and one of the Naviculæ whose lines it will resolve, though not too readily—one with diagonal lines being best for this purpose. Adjust the screw collar for an *uncovered* object, and let the cover on the slider be a thick one, or interpose another piece of thin glass; better also for the object to be mounted in balsam. Turn down the wick of a lamp and remove the light till there is barely light enough to see the lines yet only on a part of the valve; fixing the eye on a portion of the surface where the lines seem to be hidden by a dark shade, adjust the front lens for the thickness of cover, and this shade will disappear; the lines will come out and the whole object *appear* better illuminated. Compare this effect of correcting the spherical aberration by the screw collar, with that of suffering it to remain uncorrected, and bringing out the additional lines by bringing the lamp nearer. The two effects may be made the same.

An objective may bring out a single set of lines on a Diatomaceous test, especially if sunlight be employed, in a strong and bold manner (though thickened and perhaps highly prismatic) when its deficiency of spherical correction shows them through a mist and does not show a perspective definition of general form. Among the Diatomaceaæ, the genus Nitschia was established by Hassall who yet makes no mention of its most distinctive characteristic, the prominent keel, which strikingly distinguishes it from Synedra (*Exillaria*), as shown by the Rev. Wm. Smith: yet the founder of the genus, though he expressly notices the connection of the two genera, failed to point out this mark of difference which at once attracts the attention if a first rate objective be used.

If angular aperture be unnecessarily large, we have the disadvantage of a useless or injurious limitation of focus—even supposing the *working distance* to be not too inconvenient. Taking the semi-diameter of front lens as radius, the working distance is the tangent of the inclination of the extreme rays: when this inclination, as in large apertures, is small, the tangent varies more nearly as the angle, and any error of focus causes the outer rays to have more aberration. View of depth is therefore necessarily more limited. Still, for extremely slight elevations and depressions, and for very thin objects, some restriction will afford a more exquisite discrimination, provided the spherical correction is carried to a degree of perfection in due proportion to the angle. Indeed, whatever tends to bring the performance of an object-glass nearer to mathematical exactness, must limit its focus. Stop off aperture and we see farther in depth, because we see more indistinctly in regard to minute details. Again, we may gain the same advantage by so setting the screw collar as to increase the spherical aberration. Since the longer the focus of a glass, the more power will it have over depth, the ordinary resource is, to employ an objective of lower magnifying power. By whatever means the image is enlarged, the

* Micrographia, Essay on Solar Microscopes, 1839.

points of the object which form it must lie more nearly in the same plane; higher eye-pieces or longer tubes have the same effect as higher objectives. The question of "pleasantness" in regard to degrees of aperture, will, therefore, depend upon the investigations in which individual observers are employed, and their tastes and acquired habits. The most interesting suggestion of possible evils from very large angles, is that lately put forth by Mr. Wenham: that the projection of a solid upon a front lens near its margin being almost that of a side view, when extremely oblique, a number of different projections are thus made to overlap each other in the image. It is very instructive to repeat this gentleman's experiment. Looking at an insect's egg-shell with a circular opening, the plane of the circle lying oblique to the horizon, a right hand and left hand view of the circle gives different elliptical projections. These different ellipses may be produced by interposing a slip of card and cutting off alternately the right and left sides of the front lens of the objective. We thus gain two different forms of the object, both of which are received together in ordinary microscopes. The same change of form may be effected by covering one-half of the eye lens of the instrument. Mr. Wenham's figures were taken by a $\frac{2}{3}$rd object glass. The effect becomes much more striking when we experiment with a higher power and an angular aperture three times as wide. But whatever be the power or angle, if the definition be good the upper and lower sides of the circle *are not in precise focus at the same time.* It is not necessary for producing these changes of form to cut off a part of the pencil at all; as we carry the focus from the upper to the lower edge, the ellipticity of the figure is plainly seen to change, as evidently by the laws of geometry it must do, from the change of angular direction of its different points to the lens. Instead of the right and left, the upper and lower sides of the lens may be cut off, a requisition for which stereoscopy does not provide, although it may be thought of importance in regard to large apertures. Again, if we bring into focus the under side, say, of the circle, we may notice a slight mistiness about its general outline, which may be removed by cutting off half the objective front lens, or of the eye lens. But on more careful examinnation, we shall perceive that we are bringing no one point into a perfectly accurate focus, and at the same time concentrating our attention upon it. If these two things be attended to, all mistiness, thickening, and uncertainty, will disappear from such objectives as this gentleman employed. Such facts are no real obstacles to microscopic accuracy. They occur equally in unaided vision, whether of small or of large objects. If possible, we hold a solid body—a crystal for instauce—in the hand, and turn it about, yet each change of position projects a different geometrical figure. The laws of vision are the same with a microscope as without, and no perfection of instruments can supersede the necessity of comparing different views and of arriving at a knowledge of the third dimension in space, through operations of the mind.

In some cases a restricted focal distance is both convenient and advantageous: one is when we look through a set of markings. The Stauroneis pulchella of Rev. Wm. Smith is described by him: "striæ very distinct, 30 in .001″, punctate; puncta hexagonal." In his introduction, Mr. Smith remarks. "The experiments and authority of Prof. Bailey place the existence of an internal membrane (in the Diatomaceæ) beyond all doubt."—"In Stauroneis pulchella the membrane in question possesses an unusual degree of firmness, the siliceous valves, after a slight maceration in acid, may be seen to fall away from the internal membrane and to leave the latter unaltered in form."

Specimens in balsam from London, prepared by the author of these remarks, exhibit the following appearances: under a $\frac{1}{4}$ of between 60° and 70°, with a working distance sufficient for a Lieberkuhn, and having (to quote the term applied by the Jury of the Great Exhibition) the "exquisite" correction of Smith and Beck, they show by an achromatic condenser, the hexagonal puncta in three sets of lines, yet obscured in definition, and confused by the mingling of what seem like shadows.

Intense illumination of a suitable obliquity and direction, exhibits a set of fine striæ in a plane *above* these puncta, and running in directions which coincide with neither of the lines of puncta. So far, some would make the objection of "optical appearances." But when the focus is limited by the joint influence of the still more perfect correction, and the increased angles of the $\frac{4}{10}$ of 100°, the $\frac{1}{5}$ of still larger angle, and the $\frac{1}{8}$ of 120° to 128°, these two distinct sets of markings may be seen with either perpendicular or oblique light, simply by carrying the focal distance from the one to the other, and without changing the illumination. The upper striæ are at the distance quoted; the hexagons below are twice as distant; each set in turn may be seen in its own plane, and without confusion from the other. We do not refer to these hexagons as an instance of the interior membrane referred to in the passage just now extracted, which seems to indicate a different one. The appearances are the same on every specimen, and fragment, whether lying flat or edgewise. The striæ are similar, only more difficult to distinguish with accuracy, to the *fine* diagonal markings on the surface of Triceratium, Actin-

ocyclus, Coscinodiscus, and other genera which have large hexagonal cells.

An able optician from Berlin says that the importance of spherical correction is but imperfectly understood in Germany: we thus find accounted for the mistakes of Ehrenberg, which have caused so much surprise, and Dr. Hannover's omitting all mention of a screw collar, in a work of such merit as to be selected for translation into English.—*Sill. Jour.*

APPLICATION OF MANUFACTURED PEAT TO THE ARTS.

Numerously and extensively distributed as are the mineral products of these islands, the use of which for ages has contributed to the wants, the comforts, and the progress of man, there is yet one production of the soil, which, although known for centuries as a domestic fuel, possesses many peculiar and rare qualities, which have yet to be fully developed, and which, we believe, at no very distant day, will be productive of many new sources of industry of the utmost value to the manufactures and the arts. Peat, by destructive distillation, yields numerous valuable products, light and heavy oils, tar of a peculiar character, acetate of lime, ammonia, paraffine, or stearin of the purest kind, leaving behind a valuable residium of pure charcoal. The chemical conditions attendant on each of these products are, however, extremely variable, and many as have been the patents taken out for peculiar modes of manipulation, it is still an open question whether the costs of the several processes, each requiring expensive means of refinement, will allow them to be rendered commercially valuable.

Among the several companies, which we have from time to time noticed, was the Great Peat Working Company, of Ireland. Although the Company may have been considered defunct for the want of support, and the difficulty of raising the necessary capital for carrying out the works on a large scale, operations have never been suspended, but have been carried on by private enterprise; the charter remains in full force, with all its privileges intact; the company is still in existence, and is now being again brought before the public; the processes of the patentees, Messrs. Gwyne & Co., greatly improved and perfected, and a market secured for any quantity of produce for which machinery may be erected to execute at highly remunerative prices. The products under these patents are peat coal, peat charcoal, peat tar, acetate of lime, and sulphate of ammonia in a crude state, produced entirely by mechanical operations; and although chemical changes occur, and affinities take place during these processes, it is not considered a chemically working company. In the manufacture of peat coal, the turf in its wet state is put into a centrifugal machine, when by rapid motion, and hot air or steam, it is dried; or the turf having been dried in the usual manner in the open air, by which half its moisture is driven off, is placed in a mill, and ground to powder. An endless band, having attached to it a series of shelves or lifts, passes under the spout of the mill, and continually raises the ground turf to the necessary height, from whence it falls into the top one of a series of cylinders, rotating in a furnace chamber leading to a chimney. These cylinders are placed diagonally, each in an alternately different direction, and kept in rotation by cogwheel gearing; and as the powder falls through from one to the other, it leaves the lower one, in the hottest part of the furnace, entirely free from hygrometric moisture. In this heated state, and in full possession of all its bituminous matter, it passes to the pressing or brick-forming machine, where three volumes are compressed into one, and one machine producing 60 four-pound bricks per minute, forming a fuel equal in density to coal, entirely free from sulphur, forms no clinkers, stands the blast superior to coal, and holds many peculiar advantages over the latter fuel in the smelting of iron and other metals, from its chemical constituents and its behavior under combustion, promising some extensive and important changes in those important metallurgic operations. Large and continuous contracts can be immediately entered into as soon as the Company is sufficiently prepared to carry out the works on an adequately extensive scale.

The valuable qualities of peat charcoal or coke for various purposes, and for smelting iron ores, has long been recognized in Germany and France, and Sir R. Kane, in his *Industrial Resources of Ireland*, gives many interesting details of successful results. Under the Company's patents the charcoal is prepared from the compressed peat, or peat coal, forming a highly dense coke of great purity, giving out a powerful heat, and free from all noxious impurities or alloys. They do not profess to separate the steam or oily matters from the tar produced, but obtain the entire product in a highly refined condition, containing all the properties of wood tar, with many important ones additional, and is coming into extensive use for the preservation of timber by a new process, appertaining solely to the company; and for the manufacture of a superior gas, having two-and-a-half times greater illuminating power than coal gas. A lighter description of charcoal is also manufactured, easily pulver-

ized for agricultural, deodorizing, and sanitary purposes.

In connection with this subject, we have to notice a singular geological discovery at Deptford, in Kent, a distance of only four miles from London, which, if it should prove of any extent, will form a question of considerable importance to the Geological Society, as well as to all those who identify themselves with this truly interesting science. Mr. Gwyne is the patentee of the Balanced Centrifugal Pump, which caused so much attention in the great exhibition in 1851; and having recently received orders for the erection of one at an establishment at Deptford, about half a mile from the banks of the Thames, the men, in commencing to sink through firm London clay, came at a depth of three feet from surface upon a bed of peat, apparently possessing every characteristic of the generality of peat bogs in different parts of the country, composed principally of the vegetable *sphagnum*—the true peat plant. From experiments made at Messrs. Gwyne, Son & Co.'s premises, Essex Wharf, the result has proved very satisfactory. Whether this should prove a bed resting on the chalk, or in a basin of the London clay again covered by that deposit, it gives rise to a question of singular import—How came a portion of geologically recent alluvial deposits beneath the upper stratum of the tertiary period?—*Mining Magazine.*

ENGLISH SONG BIRDS.

BY JOHN HOOPER.

The lover of his country is well pleased at every improvement calculated to bring forth and develop the resources of that country, and thereby secure its permanent prosperity. But his wishes and his hopes are not confined to the actual utilitarian improvements, but extend to the ornamental and beautiful; and though his chief efforts are directed to accomplish the first, his heart exults with delight at the discovery or addition of any object which will increase the beauty, and expand the pleasurable interests of the land.

It was with such sentiments as these, that a few individuals, members of the Natural History Department of the Brooklyn Institute, were embued, when they expressed the desire to import the choicest song birds of England, with the hope of acclimating them to this country, that they might thereby realize the long-cherished idea of increasing the beautiful, the poetic charms, always abundantly abounding in the feathered races around our dwellings. They had seen or read of the enthusiastic feeling created in England by the charming melody of their songsters. They had read the poets eulogy, they had seen the naturalist's delight in speaking of the nightingale, the song thrush, and the black bird. They had witnessed the fullness of heart in which the very clod-breaking emigrant spoke of the skylark, and that even the time-worn, and hope-broken amongst them, amid penury and want, with none but heedless strangers near, would look up with smiling memory at the mention of robin red-breast.

It was thus that they resolved the experiment should be made, and to carry into speedy and actual operations their desires. In the summer of 1852, they appointed a committee of three, members of the Society, for that purpose. The committee consisted of John Hooper, Samuel Lounsbury, and Nicholas Pike. The location fixed upon as most desirable for the experiment was Greenwood Cemetery.

In the interim, Mr. James Watters, a gentleman always on the alert when the exaltation of his country or his race are at question, met Mr. Perry and urged upon his attention the proposition. And that gentleman, always desirous to add interest to the Cemetery, at once fell into it, and guaranteed $125,00 towards its accomplishment.

The Committee without delay wrote to Mr. T. Woodcock, a gentleman ever active in the interests of the Brooklyn Institute, and who was then a resident of Manchester, England, requesting him to purchase such birds, &c., as he knew were best calculated to fulfill the objects desired. And in the fall of that year Mr. Woodcock purchased 50 woodlarks, 50 skylarks, 20 black birds, 20 thrushes, 50 goldfinches, and 20 robin red-breasts. Mr. W. being about to visit the United States, brought them with him; but in consequence of the robins being confined in one cage, their well known disposition to destroy one another had free scope for action, and we suffered their loss. Upon their arrival in New York they were given to my charge, and I kept them until the latter part of last April, when they were all set free in Greenwood, under the charge of a man on the grounds appointed by Mr. Perry for that especial purpose. Several times on visiting the grounds, I saw the goldfinches, and the man stated that they all returned to the cages daily for the food he supplied them with. In the middle of the month of November, when the weather was severely cold, six thrushes were seen in Brooklyn apparently seeking food, and we have reason to believe that they were part of our stock from Greenwood.

The success of the experiment cannot be proven until next spring of actually locating them in Greenwood; but we have cause to hope by reasoning from analogy.

Mr. Smith, from Rukenhead, Eng., brought

over about 70 skylarks about 15 years ago, for that purpose; but in consequence of some disagreement with the mate of the ship, the birds were turned loose at the Narrows,—Mr. Smith feeling disappointment, but not discouraged. On the following summer he imported a fresh lot, and set them free on Long Island, near Cypress Hills. These birds located themselves on Gen. Johnson's market farm, at the Wallabout, between Brooklyn and Williamsburgh. They left every winter and returned in the spring, building, and rearing their young frequently in the same spot, for years in succession. And some of the members of our Society paid annual visits to witness their progress and be assured of their return. This they did every spring until two years ago, when the farm was sold for building purposes, and the larks were consequently scattered abroad. The last summer I saw one of them rising in the air in full song at East New York, when I alighted from the carriage in which I was riding, and made inquiry of an Englishman, resident there, and he informed me that he had seen seven or eight larks on the wing in full song at the same time last spring, and though he was surprised at the fact, he considered them consequently natives of this country. I saw four rise in a week afterwards in the same location; and I fear not but the skylark is now well established in this country.

From the fact of their annual return to the location they first adopted, we have good hopes that our Greenwood birds will do so likewise; and it is not until this fact has been proven that we can claim the experiment successful. But even should the birds not return to Greenwood, they will find an abiding place in some, more to them, congenial locality, and future generations will appreciate our efforts.

In introducing the song birds of Europe to this country, we claim to be free from the common prejudice entertained, that the American birds have no melody, and the American Flora no perfume. For we are fully aware of the folly and ignorance of the accepted libel, and point with satisfaction at our beautiful Stalia, or blue bird, whose song and domestic habits are so highly appreciated by every American eye and ear, as the robin red-breast is in its native land. We are familiar with the sprightly and plaintive melody of the yellow throat, owl, robin, boblink, grosbeck, and three score warblers, enlivening every thicket; and though last, not least, the plaintive melody of philomela must give way to the plaintive melody of that sweet Bethoven of our woods, the brown thrush. Would that its duration were equal to its melody. And if we had none of these, a little farther south we have a bird most glorious, which, in its native haunts, possesses qualities of grace, vivacity and melody, which can challenge the world to vie with it—I mean our own beautiful mocking bird.

The same parallel could be drawn of our Flora. But we were actuated solely with a desire to extend the beautiful by adding beauties to the beautiful. If we have been successful, we have received our reward, and urge others to do likewise. If any one will do so, I volunteer to take charge of them in this country, and use my earnest efforts to its success, free of cost or price, it being a labor of love.—*Proc. of the Farmers' Club, March 7th.*

REMARKS ON FISH.

The following ramarks, made by R. I. Pell, Esq., at the Farmers' Club, March 7, will be read with interest:

Naturalists divide fishes into two tribes, viz: The osseous and the cartilaginous. In the former, the bones are hard, and contain a large percentage of phosphate of lime; in the other, soft, and consist chiefly of cartilage. This description, however, is not precise, for osseous fishes have cartilage, and the cartilaginous fishes possess calcareous matter in their bones. Fish, generally, are very voracious, the greater number being carniverous, feeding upon each other —the great upon the small. I have frequently observed the pike leap several inches out of the water and take a mouthful of small fish, that were nibbling around a piece of bread. If we make a meal on fish, we find that a large quantity is necessary to satisfy us, and though not so strengthening as animal food, it occasions much less febrile excitement, and is particularly well suited to persons of studious and sedentary habits. Fish differ in their nutritive and other properties, like other animals, much depending upon the modes in which they are prepared. Its flesh is preferable in a fresh state---salting, drying and pickling alter its properties.

The flavor is likewise influenced, in a degree, by the nature of their food; on this account the same variety of fish varies in its taste on different sea coasts, lakes and rivers. Every part of the fish may be eaten with impunity; the roe is particularly nutritious and wholesome, and forms a delicious food. Caviare is the prepared roe of the sturgeon. It is steeped in brine, dried, and pressed into tubs, and used extensively by the Russians as an article of food, during the season of Lent, in the Greek Church. In the Caspian Sea there exists a species of sturgeon called the sterlet; the caviare prepared from the roe of which is expensive, and used exclusively by the Royal Family of Russia. As far as my experiments have gone, I am convinced that almost all salt water fish, may be kept in fresh water ponds, and that they will increase

rapidly in size, and improve much in flavor, if properly fed upon liver cut in small pieces, damaged rice boiled, or Indian meal mixed with blood, stale bread, &c. After one week's training they will always come when called, and soon become more confiding than tame pigeons, or barnyard fowls. In China, the art of fattening and preserving fish has been carried to great perfection; near Canton, fish-ponds are formed by excavating the ground, and as many store fish placed in them as they can conveniently hold. They are fed morning and evening with boiled rice, and occasionally with animal food. They grow from four inches to nine in a few months, when they are considered marketable; draughts are then made, and the fish conveyed to market in large shallow tubs of water, alive, as they will not purchase them if dead. The spawn of fish is regularly transported from Province to Province, and deposited in proper breeding ponds, where it is hatched, and the fish kept until large enough to take care of themselves, when they are thrown in ponds among large fish.

A few days since, I met the butcher of the steamship Pacific, with a basket full of sole (Pleuronectes Platissa), which he had brought from Liverpool in ice, and I compared them with two varieties of flat fish, known in the market as flounders, and must confess that I could perceive no difference between them, and am firmly of the opinion that they are the self same fish. The sole, next to the turbot (Pleuronectus Maximus), is considered the best flat fish in England, inhabiting the northern seas, the Mediterranean and Baltic. It is a firm, white, delicate, delicious fish, and in the highest perfection for the table, about midsummer. They do well, and breed in fresh water ponds. It is peculiar in its appearance, both eyes are on the right side, and its mouth, which is much distorted, is on the opposite side. It has small teeth in both jaws, the form of the body is oblong, with dorsal and anal fins extending to the tail.

Fish are oviperous vertebrate cold-blooded animals, having a heart consisting of one auricle, and one ventricle, which breathe water, the principal organ of respiration consisting throughout the whole class, of branchiæ, or gills, which are attached to the hyoid bone, and covered with numberless minute close-set blood vessels. The water fish take in at the mouth is not swallowed, but passes through the gills, and escapes by the gill apertures. The air contained in the water acts upon the blood, which is subdivided in the branchial vessels, and after having been de-carbonized, is propelled to all parts of the system. They have a bladder located below the spine, by the compression or dilation of which they vary their specific gravity. They have no neck, which renders the after part of the body more free for motion.

The fins are composed of a thin membrane of great elasticity, supported by rays. The principal organ of motion is the tail; the dorsal and ventral fins balance the fish, and the pectoral is made use of to arrest his motion. The teeth of fishes are almost entirely osseous. Their scales are composed of two substances—one resembling horn, the other bone. They are attached to the skin by their anterior edges, and consist of concentric laminæ, or rings. In the scale fish I think they reckon the age of the fish, and in the fish without scales I imagine the age is indicated by the rings in the vertebræ of the back bone. It is difficult to distinguish the sexes of fish except in the spawning season. When the male fish is in condition to impregnate the ova his milt will be soft, and flow readily by pressure; at other seasons it is quite hard. The eyes of the fish are differently placed, according to its habit; they have but little taste, and are not easily moved by being touched.

It has been generally supposed that fish are not possessed of the sense of smell. From several experiments that I have tried with three varieties, I am convinced they have—for example, a hook well baited with an angle worm was placed enticingly before a perch weighing one and a half pounds; he did not take the least notice of it. After encircling him five or six times, it was withdrawn, and a drop of the oil of rhodium was brought in contact which was then dropped very carefully several feet behind the fish. Almost immediately he turned and seized the bait. Others, not before in sight, likewise made their appearance, when the same experiment was several times repeated, first with an unscented bait, which was spurned, and then with the scented, which was at once seized. Again, it has been denied that fish have the sense of hearing. I find them very sensitive to noise, and by numerous experiments am convinced their sense of hearing is acute.

We have a species of fish in the Hudson river, known as the bull head, that build a regular and well formed nest in the mud, among the river weeds, and there watch over, and guard with unceasing care their tender offspring, and I have frequently known them to be thrown in great quantities from nests upon the shore at low water, during the prevalence of an easterly gale. Boys and men are often engaged on the flats in the river searching for bull head nests, and when found the fish become an easy prey, as they are very loth to leave their habitations.

The American carp likewise form large concave circles in the gravel near the shore, which they cleanse and keep in the most perfect order, and there the ova are deposited and watched with intense solicitude by both male and female,

and if any fish attempt to enter they are at once attacked most fiercely by the carp with distended gills, and driven off.

I have known the golden carp of China to be frozen solid, and when the ice thawed the fish was as lively as ever.

The eel is the most universal of all fish, and is, I think, produced by the deposition of the ova by the female, and impregnated by the male, in the same manner that other fish ova are; but probably in the ocean, as myriads of transparent animalcules may be seen at the mouth of all our rivers in the spring of the year, early in the evening, on the surface of the water, slowly wending their way towards the tributaries, If examined with a microscope, the animalcules will be found to be eels. They are supposed to have no scales—this is, likewise, an error; with a glass you can perceive thousands of small scales completely covering the eel. They frequently leave the water at night, and search for insects in the grass; are tenacious of life, and will move after they are skinned and cut up.

Old persons should not eat fish often, as they are much less digestible, and contain far less nutriment than roasted animal meats. Fish are apt to putrify and cause deleterious fermentation in the human system. The most pernicious are probably shell fish, being apt to produce erysipelas, when at all tainted. Herrings, mackerel, eels and salmon are the most unwholesome, because they contain oil. The best sorts are flounders, perch, smelts and haddock, and they should be boiled and not fried; in times of contagion fish ought not to be eaten.

Fish of all descriptions, whether stale or fresh, form an admirable and exceedingly enriching manure; the outer covering contains a large percentage of gelatine; their scales chiefly hardened albumen; the portions directly under the skin, fat and oily substances; their flesh much oleaginous matter, and considerable nitrogen. The bones are rich in phosphate of lime; these decompose slowly in the soil, and are converted into gaseous matters, which are the breath of vegetable life; such, for instance, as carbonic acid gas, and carburetted hydrogen. In fact you cannot possibly have a better fertilizer, but it only serves the agriculturists for a single crop. Consequently as 30 bushels are required to manure an acre, countless myriads would be necessary to meet the demand; the supply, however, will keep pace with the wants of the farmer, if my fish bill passes the Legislature, compelling fishermen to plant the ova of a few fish annually upon their fishing grounds.

Under the head of fish, it is scarcely proper to introduce the leech, notwithstanding it is a genus of aquatic animals, but as I have given the cultivation of this useful little creature considerable attention, I will take the liberty of saying a few words on the subject. Some ten years since, I purchased in this city a large number of Swedish leeches, and stocked several ponds with them. It is a genus of suctorial animals, provided with a sucking apparatus at one end, and a mouth at the other, which is tri-radiate, possessing cartilaginous jaws, fitted with cutting teeth, so disposed that the three edges form three radii of a circle, consequently the bite is tri-radiate; the sucker forms a vacuum, and the blood flows readily. The leech has a long stomach, with cæcal sacs, which it fills rapidly, but digests slowly. A single meal suffices for a whole year, at the end of which time a portion of the same blood, undigested, but a fluid form, may be observed in the stomach. Its skin is composed of about one hundred soft rings, by means of which it moves rapidly in the water. On dissecting one, I found it to be viviparous, and a hermaphrodite, containing but one egg, enveloped in a cocoon, and covered with the excretion of porous matter, unlike any thing I have ever observed in any animal before. It attains maturity in five years, and is of no use for medical purposes before; they prey upon each other, and are liable to numerous diseases, and parasite animals—they breathe by their entire surface. I tried a singular experiment with one last summer; thus—after attaching it to a rabbit, I cut off a small portion of the tail end with a scissors, as it filled itself, the blood passed off, the creature feeling relieved, continued to suck in order that the deficiency might be made up. If leeches become scarce one may be made to do the duty of many.

PHOTOGRAPHIC PROCESS.

BY MR. C. J. MULLER.

The following photographic process has been communicated to us by Mr. C. J. Muller, from Patna, in the East Indies. We have submitted it to an experienced photographer, and he informs us that it offers many advantages over the Talbotype or the Catalissotype of Doctor Woods, which it somewhat resembles; that it is easy in all its manipulatory details, and certain in its results. We give Mr. Muller's own words:

" A solution of hydrodate of iron is made in the properties of eight or ten grains of iodide of iron to one ounce of water. This solution I prepare in the ordinary way with iodine, iron-turnings and water. The ordinary paper employed in photography is dressed on one side with a solution of nitrate of lead (fifteen grains of salt to an ounce of water). When dry, this paper is iodized either by immersing completely in the solution of the hydrodate of iron, or by floating the leaded surface. It is removed after

the lapse of a minute or two, and lightly dried with blotting paper. This paper now contains iodide of lead and protonitrate of iron. While still moist, it is rendered sensitive by a solution of nitrate of silver, (one hundred grains to the ounce) and placed in the camera. After an exposure of the duration generally required for Talbot's paper, it may be removed to a dark room. If the image is not already out, it will be found speedily to appear in great strength, and with beautiful sharpness, without any further application. The yellow tinge of the lights may be removed by a little hyposulphite of soda, though simple washing in water seems to be sufficient to fix the picture. The nitrate of lead may be omitted; and plain paper only, treated with the solution of the hydrodate of iron and acetic acid may be used with the nitrate of silver, which renders it more sensitive. The lead, however, imparts a peculiar colorific effect. The red tinge brought about by the lead may be changed to a black one by the use of a diluted solution of sulphate of iron;—by which, indeed, the latent image may be very quickly developed. The papers, however, will not keep after being iodized."

Mr. Muller suggests, that as iodide of lead is completely soluble in nitrate of silver, it might furnish a valuable photographic fluid, which could be applied at any moment when required.

No small degree of interest attaches to this process, originating in experiments carried on in Central India. It appears perfectly applicable to the albumenized glass and collodion processes.—*Athenaeum.*

The following process, subsequently published by Mr. Muller, in the Athenæum, appears to be a modification of the above:

"Plain paper is floated on a bath of aceto-nitrate of silver, prepared of 25 grs. of nitrate of silver, 1 fluid oz. of water, 60 minims of strong acetic acid. When well moistened on one side, the paper is removed, and lightly dried with blotting paper; it is then placed with the prepared side downwards on the surface of hydriodate of iron (8 grs. of the iodide in 1 oz. of water). It is not allowed to remain on this solution, for if this were the case, it would become almost insensitive. The silvered surface must be simply moistened with the hydriodate—the object being to get a minimum quantity of it diffused over the silvered surface. The photographer accustomed to delicacy of manipulation, will find no difficulty in this. While still wet, the paper is placed upon a glass (face downwards), and exposed in the camera for periods varying from 10 to 60 seconds, according to circumstances. In sunshine, when the object to be copied is bright, 5 seconds in this climate (India) is sufficient. Excellent portraits are obtained in shade in 30 seconds: 60 seconds is the maximum of exposure. The picture is removed from the camera and allowed to develop itself spontaneously in the dark, then soaked in water, and fixed in the usual manner, with the hyposulphite of soda."

NOTES ON THE RATTLE SNAKE.

BY DR. W. I. BURNETT.

By the kindness of my friend, Dr. William E. Dearing, of Augusta, Ga., (Mayor of that city, and corresponding member of this Society), I have had placed at my disposal several living reptiles for anatomical and physiological uses. Among these were two quite large and beautiful Rattle Snakes, (*Crotalus durissimus*), with which I lost no time in making many experiments. The longest, a little more than four feet in length, and having fourteen rattles,* was killed, and I made a dissection of its mouth in order to learn some details of the anatomical relations of the fangs and poison-apparatus. As the opportunity for the study of the progressive development of these was an unusually good one, I will give the results somewhat in detail.

The two fangs in use, with the poison-sacs at their base, presented nothing remarkable, excepting that they were old and worn, and evidently soon to be shed. But directly behind these the mucous membrane on each side was crowded with what may be called the *fangs of reserve;* for, like successive teeth elsewhere, they are ready for complete development in turn, as fast as those in use pass away.

These were of all sizes, from near that of the fangs in use down to the smallest germ, and I was able to easily count twelve on each side. Their development I studied with the microscope, and it appeared as follows: First, a minute involution of the mucous membrane (*the tooth follicle*); in this is seen a small conical papilla as the first trace of the future fang. This is gradually developed by the aggregation of cells, and when about one twenty-fifth of an inch in length, its cavity (the *pulp-cavity*) is occupied by a net-work of blood-vessels. The growth after this is more rapid and determinate. The epithelial cells covering the apex of the papilla become lineally arranged, and, fusing together, form fibers, which, when filled with

* The popular belief is that the number of rattles on the tail indicate the number of years of the snake's life. But according to several observers (Bachman, Holbrook, and Dearing) this is not so; for, not only may it lose several of the rattles by accident, but two and even four have been known to form in a single year. One of my own accidentally lost two of its rattles, and it is rare to find specimens having more than ten or twelve.

calcareous salts, constitute the intimate structure of the enamel. This enamel is formed very early, and some time before the appearance of the dentine or ivory; so that at one period is found simply the epithelial tooth-sac crowned with a point of enamel. As the tooth-sac increases and is pushed out, the enamel point is more and more elongated, and becomes, finally, very long and acicular, and with the sharpness well known in the perfect fang. Meanwhile the dentine, or ivory, is formed, and as this process is going on, its edges begin to roll towards each other on the convex and upper surface of the tooth. This rolling of the edges to meet each other, continues gradually with the growth of the tooth, forming first a half, and usually, at last, a complete canal. This canal is the poison duct, and being thus formed, two results ensue: — 1st. It is outside, and disconnected with the pulp-cavity, but communicates with the tooth-follicle at its base. 2d. It is only in the ivory substance, terminating, externally, at the point where the last connects with the enamel; the enamel point being free and solid.

Thus formed, these fangs seem to be in waiting to replace the old ones in the event of their being removed, or naturally shed. How this replacement takes place, I am unable to say from observation. But it appears to me that the original tooth-follicle becomes the poison-gland or sac; for several of the larger reserve-fangs had each a small sac embracing its base, which appeared to be only the primitive tooth-sac; and, moreover, the largest pair of these reserve-fangs lay directly behind the ones in use. The replacement might, therefore, occur as in the higher animals,—the pair of reserve passing gradually, together with the poison-gland, into the places of those removed.

But, however occurring, the substitution is exact and complete, and may take place in a very short time, for Dr. Dearing informed me, that from one of his captive specimens he extracted the fangs, which were replaced in exactly six weeks; this he repeated several times with the same result.

There are many facts tending to show that these fangs are naturally shed once in a while, if not regularly; at all events their points are likely to be broken off by frequent use, and, however removed, nature appears to have provided an ample stock in reserve for their almost indefinite reproduction.

The virulence of the poison of this animal is too well known for special description. I will only add there is good reason for the belief that its action is the same upon all living things, vegetables as well as animuls. It is even just as fatal to the snake itself, as to other animals; for Dr. Dearing informed me that one of his specimens, after being irritated and annoyed in its cage, in moving suddenly struck one of its fangs into its own body; it soon rolled over and died as any other animal would have done. Here, then, we have the remarkable, and, perhaps, unique physiological fact, of a liquid secreted directly from the blood, which proves deadly when introduced into the very source (the blood) from which it was derived!

With the view of ascertaining the power and amount of this poison, Dr. Dearing performed the following experiment; the snake was a very large and vicious one, and very active at the time. He took eight half-grown chickens, and allowed the snake to strike each under the wing as fast as they could be presented to him. The first died immediately; the second after a few minutes; the third after ten minutes; the fourth after more than an hour; the fifth after twelve hours; the sixth was sick and drooping for several days, but recovered; the seventh was only slightly affected, and the eighth not at all.

With the remaining specimen I was desirous of performing several experiments as to the action of this poison on the blood. The following is one: The snake was quite active, and as soon as any one approached the cage, began to rattle quite violently; but twenty-five or thirty drops of chloroform being allowed to fall on his head, one slowly after the other, the sound of his rattle gradually died away, and in a few minutes he was wholly under the effects of this agent. He was then adroitly seized behind the jaws with the thumb and forefinger, and dragged from the cage and allowed to partially resuscitate; in this state a second person held his tail to prevent his coiling around the arm of the first, while a third opened his mouth, and with a pair of forceps pressed the fang upward, causing a flow of the poison, which was received on the end of a scalpel. The snake was then returned into the cage.

Blood was then extracted from a finger for microscopical examination. The smallest quantity of the poison being presented to the blood between the glasses, a change was immediately perceived, the corpuscles ceased to run and pile together, and remained stagnant without any special alteration of structure. The whole appearance was as though the vitality of the blood had been suddenly destroyed, exactly as in death from lightning. This agrees also with another experiment performed on a fowl, where the whole mass of the blood appeared quite liquid, and having little coagulable power.

Other and like experiments were performed, but I must omit here their description.

The physiological action of this poison in animals, is probably that of a most powerful sedative, acting through the blood on the nervous centers.

This is shown by the remarkable fact that its full and complete antidotes are the most active stimulants, of these, *alcohol*, in some shape, is the first. I cannot better illustrate this important point, than by the two following cases furnished me by Dr. Dearing, in whose experience they occurred.

1. Mr. B—— was bitten just above his heel, three quarters of a mile from home. The usual symptoms of most acute pain and large swelling immediately followed; he succeeded, however, in reaching his house, but complained of blindness and universal pain. Brandy was then given, to the amount of a quart in the course of an hour; this produced a little nausea, but not the least intoxication; in the next two hours another quart had been given, followed with relief of pain and subsidence of swelling, but without the least intoxication. Stimulants were kept up in small quantities during the ensuing forty-eight hours, with the gradual passing off of the local and other symptoms. The patient kept his room the three following days, complaining only of a general soreness. After this, was about as usual; but a few weeks after, all his hair fell off.

2. Miss F—— was bitten on her middle finger. The usual severe symptoms immediately followed; but brandy, with the addition of a little ammonia, was freely given, and continued in large doses until relief of symptoms, but without the least appearance of intoxication, although in health, the individual could not, probably, have borne a single ounce; the symptoms gradually disappeared, and on the third day the patient was well, generally, although the finger sloughed.

These two cases, authentic in every particular, are quite valuable; for aside from their physiological relations, it is of no small importance to know that the sure fatality of such an accident can be fully prevented by so simple a remedy.

I have been desirous of performing some experiments with a view to learn the relations of this poison to the state of anæsthesia in animals. I commenced these a few days ago, but the behavior of the snake was far from being commendable or satisfactory, and I shall postpone them for the present.—*Proc. Boston Nat. Hist. Society.*

THE COTTON WORM OF THE SOUTHERN STATES.

BY DR. W. I. BURNETT.

During the past winter I have been collecting materials for the history of that most devastating of American insects, the "Cotton worm." In this I have been aided and favored by several intelligent Southern planters, whose severe losses from the ravages of this animal, have made them keenly alive to many of its habits and modes of life. Of these gentlemen, I am particularly indebted to Mr. Robert Chisolm, of Palmetto Hall, Beaufort, South Carolina. an intelligent and extensive cotton-planter, who has with much care watched the economy of this insect during several of its later appearances. He has sent me several communications, from which, together with an examination of the larval specimens with which they were accompanied, I have been able to prepare the following account:

This insect appears to be but little known in science, although the injury to property which it causes, is perhaps greater and more deplorable than that occasioned by any other with which we are acquainted. On the years of its appearance, the entire cotton crop of certain districts is often cut short; and in not a few instances, single plantations have suffered to the amount of from ten to fifteen thousand dollars.

It is one of the span-worms or *Geometridæ*, belonging to the same family of insects as canker-worm, which is so much feared by horticulturists of the north.

I have as yet only seen the larva. It is not indigenous to the Southern States, and there is no evidence that it can live naturally north of the shores of Texas. Most probably it is a native of Brazil or some other equatorial climate in that vicinity; for it is so sensitive to the cold, as to quickly die in an atmosphere even approaching the freezing point. It appears, then, on the Southern cotton fields, always as in migration, coming suddenly like a foreign enemy, and always selecting the most thrifty plantations. It is very remarkable, therefore, that it should appear regularly at intervals of every three years in the same districts, striking first the seaboard and then progressing gradually inland as circumstances may favor. But equally remarkable in this connection is the fact, that its most extensive and deplorable ravages occur always after intervals of twenty-one years, or every seventh time of its advent, as shown in the years 1804, 1825, and 1846, during the last half century. These facts are inexplicable, unless referable to some peculiar conditions of their economy in their native land. Little is known from what southern direction they come; for like all insects of this family, their movements are made at night, and the seaboard planter often rises in the morning to find whole sections of his plantations covered with the adult insects busily engaged in depositing their eggs on the tender leaves of the cotton. There is, however, no regularity in the exact month of their coming, for Mr. Chisolm says that on his plantations they came in 1840 quite early, but in 1843 much later, and remained until frost; in 1846, in June, and in 1849 and 1852 in August.

The cotton-caterpillar is nearly always accompanied directly by another insect called the Boll-worm (probably one of the *Noctuidæ*) which confines its attacks to the immature lint and seeds of the green pods of the short-stapled variety of cotton; and, as short cotton is mostly cultivated in sections farther south than those of the long-stapled variety, this boll-worm is generally seen in Texas and Mississippi six weeks or so before the cotton-caterpillar proper appears on the coast of Georgia and South Carolina. Little is known of its habits more than this; for its ravages are comparatively so inconsiderable that it attracts scarcely any attention of the planter. Its concomitancy with the true cotton-worm, however, is not a little remarkable, and there is no doubt that it belongs to a different family of insects.

The cotton insect having made its appearance, shows considerable sagacity in seeking first the most luxuriant fields. The eggs, which are of a dull white color, are deposited singly, or at most in twos, on the under surface of the most tender leaves. Their period of incubation is quite short, being six or seven days, and the time of hatching is always after sunset or in the night. They then begin to feed ravenously, and grow in proportion; their attacks being always confined to the long-stapled variety when accessible, though, when hard pushed, they will eat the short variety, but never any thing else; and if their numbers are disproportionate in excess to the cotton at hand, they will die of starvation rather than touch any other vegetable. During their caterpillar state, they are almost wholly unaffected by changes in the weather, excepting cold; for the heaviest rains and the severest gales of wind do not stay their movements, or prevent in the least their devastations. Mr. Chisolm says that a very violent hurricane, of two or three hours' duration, which swept over his plantations in August last, made no impression whatever on their progress. If, however, there occurs even a slight frost, they are killed throughout. These circumstances are worthy of mention, as bearing upon their probable tropical origin. Their larval state is of about ten days' duration, and, during this time, they moult two or three times, changing their colors and general appearance in the same singular manner as the canker-worm of the north. The caterpillar, when full grown and well fed, is sixteen legged, of the size of a common crow-quill, and from an inch and a quarter to an inch and a half in length, It has a reddish head, is whitish below, and brownish black above; on each side are two longitudinal, wavy, white lines, and another, straight, on the middle of the back. When ready to wind up, they swing down from the cotton plant, and, without any choice, take up indifferently with the nearest objects, on which they may rest during this process. Their chrysalid state continues about twelve days; the moths then appear and immediately go about depositing their eggs, after which they die. This perfect state lasts only four or five days. Such is the routine of their reproduction. When they appear early in the season, there are usually three broods; but some years they come so late that only a single new generation is seen. In either case, the last brood almost invariably perishes throughout, being either killed instantly by the frost, or dying from starvation, having eaten all the cotton before their transformations take place. It follows, therefore, that these ravaging insects as they appear in the cotton fields of the south, do so at the loss of that portion of their race, for they leave no progeny behind them. At the same time, this condition of things makes the matter the more deplorable for the planter, for, as he has to contend with a suddenly invading foe from foreign parts, he is rendered wholly powerless in averting this regularly periodical destruction of property.—*Proc. Bost. Nat. Hist. Soc.*

THE PRACTICE OF PHOTOGRAPHY.

BY PHILIP H. DELAMOTTE, F. S. A.

The discovery of the art of photography is due to Mr. Fox Talbot, who, early in 1839, communicated to the world the result of his experiments, and an account of the processes by which they were conducted. This discovery was so startling, and its capabilities so wonderful, that the whole scientific world was interested in them, and directed its attention to their development; with what result we need not enquire, for the evidence abounds on every side. It is due, however, to the memory of our distinguished countryman, Wedgwood, to state, that so long back as 1802, he was engaged with Sir Humphrey Davy in attempting to fix the images of the camera obscura. If he was unsuccessful, it was probably due to the imperfect state of chemical science at that period.

As Mr. Talbot patented his process on paper, much ingenuity was exerted to discover other substances and other methods by which his results could be attained; and the researches of Herschel, Hunt, Archer, and others, have given us the cyanotype, chromatype, amphitype, and the collodion process, while, at the same time, they have greatly improved the processes of Mr. Talbot himself.

These various improvements enable us now to obtain good views, portraits, &c., on paper, in a space of time varying from a few seconds to an hour and a half; while on collodion and on albumen instantaneous exposure to the image in

the focus of the lens is sufficient to obtain a good picture.

The negative pictures obtained on glass appear to possess a slight advantage in clearness and sharpness over those obtained on paper; but there are so many advantages in using the latter material, that all our skill should be directed in perfecting it. Probably our efforts would be best directed to the developing agents; the sensitiveness of the iodide of silver perhaps cannot be increased; and if, as is now supposed, the instantaneous action of light suffices to effect the change in this substance necessary to the impressing the image, it must result that it is only due to the imperfection in the developing agent that instantaneous pictures cannot be obtained also upon paper.

Processes on Paper.

The processes on paper are two—the dry and the wet; the former is the most convenient, and that generally practiced; by some practitioners the latter is preferred; we shall here describe both processes; beginning with

The Dry Method.—This process is deserving of the most assiduous cultivation; for its simplicity and ready manipulation give to it an advantage over all other methods; by it we can carry a stock of prepared papers to any distance, and after exposing them in the camera to the desired object, reserve the further stages of the process until we return to the conveniences of the operating room. Whatever imperfections now exist in this method, and they are but few, will doubtless soon be overcome: the results obtained at the hands of several eminent photographers leave but little to desire; in fact, in many positive proofs it is difficult, if not impossible, to discover whether they have been obtained from negatives on glass or on paper.

The paper used for the negatives can be employed either waxed or unwaxed. As good results are attainable from the one as from the other; the employment of the latter saves much trouble; and the proofs can be rendered transparent by waxing *after* they are developed.

The quality of the paper used is of vital importance in this process; it must be as thin as possible, but of perfectly homogeneous texture throughout.

The proportions of iodide of potassium and nitrate of silver in the solution employed differ much in the practice of various photographers; the best result is most probably obtained when the quantity of silver in the iodide of that metal is in excess, for true iodide of silver [that is, when these two bodies are combined in definite atomic proportions] is not acted on by light.

We now proceed to detail the processes with waxed-paper by the dry method.

Waxed-Paper Process.

I. *Selection of Paper.*—The early photographers encountered great and discouraging difficulties in procuring paper suitable for the purpose of their art, which now no longer exist. Good papers are easily obtained of various degrees of thickness, uniform texture, well-sized and glazed, both of English and French manufacture; some prefer the former, others the latter. The difference in their quality appears to consist in this—the English papers are hard and dense, owing to their being sized with gelatin, consequently the sensitive preparation does not penetrate its substance, but remains on the surface. They are, therefore, best fitted for positive proofs. The French papers, on the contrary, are generally sized with starch, with which iodine enters eagerly into combination: they are usually thinner and lighter, and consequently better adapted for negatives; but both English and French papers are prepared for positives and negatives, and the photographer can select either without any reserve; only with this precaution, let him avoid using different papers as much as possible, for the difference in their manufacture causes them to be affected differently under the same treatment. If bought of an honorable dealer in apparatus, &c., there is little fear of an unsuitable material being offered for sale. All the success of manipulation may rest upon the quality of the paper.

Previous to using the paper, each sheet must be examined for spots and holes; if any such exist that sheet must be rejected. The demand for a fine material for the purposes of photography has become so extensive, that several manufacturers have devoted their attention to the preparation of a pure paper, and the result is all a photographer can desire. Among English manufacturers, Whatman, Nash, and Turner, are eminent; Lacroix, and Canson, freres, are the most eminent of those of France. Lacroix's paper appears to give the greatest rapidity, doubtless owing to its containing the largest quantity of starch. For waxing, thin paper will answer as well as thick, if of homogeneous texture.

Preparation of the Waxed Paper.

Suitable waxed paper for photography has only just become an article of commerce; the preparation of it is troublesome, but worth submitting to from the great facilities it affords in promptlp obtaining pictures [negatives]. The mode of preparing it is as follows: Take a daguerreotype plate, or polished steel or copper-plate, such as are prepared for the use of engravers, but larger than the paper to be waxed, and place it on a stand so that a gas burner can be passed under, and maintain it at a steady temperature; when the plate is sufficiently warm, rub it all over with a

piece of clean white wax; then lay upon it carefully a sheet of thin negative paper, so that no air-bubbles are formed, and as soon as it is penetrated by the wax, cover it with another sheet; have ready a second heated plate, upon which put a sheet of the unwaxed paper, and place upon it the two waxed sheets, cover them with a sheet or two of unwaxed paper, and allow the excess of wax to be absorbed by them, by which means any waste of wax may be avoided; repeat this operation so long as any excess of wax is absorbed by the clean paper; finally place it between several more fresh sheets, upon the clean hot plate, and pass over them a hot smoothing-iron until the whole excess of wax is removed. This operation is best performed by two persons, one to each plate; as the wax cools so rapidly when removed from the hot plate, much time is wasted in the manipulation when performed by a single person. The first plate being rewaxed, the paper used for absorbing the excess of wax is placed upon it, in order to become thoroughly saturated, and then removed and treated as before directed. The preparation of a hundred sheets in this manner is a good day's work.

The kind of paper best suited for waxing is a very thin quality manufactured by Lacroix, and Canson, freres: it contains a large quantity of starch, which increases its sensitiveness.

This waxed paper possesses some excellent qualities, which render it exceeding valuable to the photographer. It is transparent, which enables him to perceive the smallest bubble of air that exists between it and the exciting solution upon which it is floated: it has become exceedingly tenacious, somewhat resembling vellum; and it will admit of a proof being left in the developing solution for a considerable time, without spotting or staining the solution; but, above all, it permits us to prepare sensitive paper with the nitrate of silver, and keep it ready for use during many days, weeks, or even months. This quality is of immense value for operations out-of-doors, since it is no longer necessary to carry a cumbrous and fragile array of bottles and dishes; a portfolio and a camera suffice for a long journey. The waxing also enables us to obtain much deeper blacks upon thin paper than we could were it not employed.

For the benefit of those who have not much time to spare, we may remark that waxed paper is now extensively prepared for sale, and may be obtained of most of the respectable dealers in photographic materials.

Preparation of the Sensitive Paper.

To increase the sensitiveness of paper for photographic purposes, it is found useful to prepare it with a coating of some organic substances, which act upon the nitrate of silver with energy, and render it almost black. For this purpose the French chemists have suggested sugar of milk and starch [175]; this latter has the additional recommendation of entering into combination with iodine.

Starch exists in many vegetable grains, roots, etc.; the best for the purpose of photography is obtained from rice. To prepare it, take

Distilled water	3 pints.
Washed rice	4 ozs.
Isinglass*	½ oz.

Boil them in a glass or porcelain vessel, and filter through a clean cloth. The boiling must only be continued so long as the grains of rice begin to break, and stopped before the water is thickened by the excess of starch. This liquid, to which the following ingredients are added, gives a good body to paper, and yields very excellent tones of black in the proofs.

Dissolve in one quart of this rice water.

Sugar of milk	'693	grains.
Iodide of potassium	230	"
Cyanide "	12	"
Fluoride "	6	"

When these are dissolved, filter through a fine cloth, and preserve the liquor for use in a well-closed bottle: it will keep for a long time without peterioration. In cold weather it should be made tepid before using.

To render the paper sensitive, put a quantity of the solution into a clean porcelain dish, and immerse in it the sheets of paper, one by one, removing the bubbles of air between each. As many as twenty sheets of paper may be prepared at one time, provided the liquid completely covers them; they should be left in the liquid from half an hour to an hour, according to the thickness of the paper.

When the waxed paper is placed in the bath of iodide of potassium, that salt appears to completely penetrate the wax and enter into combination with it; the greasiness of surface disappears, and the paper takes freely the solution of nitrate of silver. This action, however, does not take place immediately, but during the space of half an hour, or an hour, before the wax becomes decomposed.

At the expiration of that time, take up the mass of paper, and turn it so that the sheets which were lowest become uppermost; then hang them up separately by one corner to drain, and to the bottom ef each sheet attach a piece of blotting paper to facilitate the dropping of the fluid.

Two different kinds of paper should not be placed at one time in the bath. Paper sized with this fluid has a light violet tint, which is not objectionable, but, on the contrary, is useful

*Genuine Isinglass is required—not the spurious substitute, *gelatine*.

in the subsequent operation, as it serves to show when the action of the nitrate of silver upon the iodide is completed.

Paper thus prepared is said to be iodized and insensible to the action of light, but too much exposure decomposes the iodide of potassium, and precipitates the iodine upon the starch.

The liquid will serve for fresh paper as long as it lasts, taking the precaution to filter it after use.

Starch, insoluble in cold water, dissolves completely in boiling water; after it becomes dry it is again indissoluble in cold water. Advantage is taken of this property to apply it to paper as above directed.

This preliminary preparation is applicable to paper for negatives, whether it is used waxed or otherwise.—*Photographic Journal.*

[To be continued.]

PROCEEDINGS OF THE CLEVELAND ACADEMY OF NATURAL SCIENCES.

REGULAR MEETING, March 28, 1854.

Prof. KIRTLAND in the Chair.

The Committee on Geological Survey reported a memorial to be sent to the Legislature, which was accepted.

The Committee to whom the species of *Cyclas* from Drummond's Island was referred, reported it to be a new species.

A communication was read from L. HARPER, Esq., of Mississippi, on the discovery of a new species of *Orioceras*.

Prof. KIRTLAND presented three species of *Polygyra*.

A fine specimen of *Chlamyforus truncatus* was presented by Lieut. PHELPS, through the Corresponding Secretary. A vote of thanks was returned to Lieut. P. for the gift.

Rev. Z. THOMPSON, of Vermont, was elected a corresponding member of the Academy.

APRIL 5, 1854.

Prof. CASSELLS in the Chair.

Prof. BRAINERD presented to the Academy a fine specimen of the Porcupine Fish, (*Diodon hystrix*).

Prof. SMITH gave a description of the process of taking photographic pictures by means of a collodion film, with specimens of the results of the process. Also, a new method of preparing paper, by which negatives may be made fully equal in effect to those taken on glass, and exhibited specimens of the same.

Dr. NEWBERRY exhibited specimens of *Meerschaum*, from Illinois.

Mr. JNO. KIRKPATRICK was elected a member.

APRIL 12, 1854.

Dr. GARLICK in the Chair.

A communication was made by Dr. ATKINSON, upon the want of a game law in the State, with an outline of a plan to protect our game and small birds from wanton destruction.

Dr. GARLICK exhibited the cast of a Muskallonge, (*Esox nobilis*, Thomp.,) which weighed forty-five pounds,—of which he had recently made dissections. The fish was a female, 4 ft. 4 inches in leagth, 34 inches in girth, and contained 497,364 eggs.

Prof. SMITH made further communication on the origin of the names of the days of the week.

The Committee on Diploma reported a form.

A Committee of three was appointed to report a device for a Seal.

APRIL 17, 1854.

Dr. NEWBERRY presented a specimen of the American Robin, (*Turdus migratorius*), sent to the Academy by M. C. READ, of Hudson, and which was nearly pure white in color.

Dr. ATKINSON submitted a form of memorial to the Legislature, for the protection of game and small birds.

THE ALLEGHENY COAL FIELD.

BY CHARLES WHITTLESEY.

Read before the Cleveland Academy of Natural Sciences.

The materials are not yet collected for exhibiting fully the *physical structure* of the great coal basin, that occupies the western slopes of the Allegheny, or Apalachian range of mountains.

The Geological Surveys began in the four States of Ohio, Pennsylvania, Virginia and Kentucky, which embrace most of this field, have not been completed, but are all suspended or abandoned.

In regard to the number of its strata, their thickness and dip, there are details so numerous, that the labor of many men, many years, is yet necessary to complete them.

The published reports made in those four States, give merely the results of first examinations or reconnoisances.

More is known of the dip, thickness and extent of the coal-bearing rocks in Ohio than in the other States.

On a map, which is before me, the general outline of the basin is marked out with tolerable accuracy, from the reports alluded to.

The dip of the beds, local and general, is represented to the eye by arrows pointing inwards om the border, towards the center of the basin, which is in Virginia, South of Wheeling

I intended to prepare from this a reduced map, and sections, so far as they can now be made, for publication in your Magazine. This is the best and only sufficient mode of representing rocky strata, but in this case it would require an expense not warranted in a journal; and I content myself with giving you such written descriptions as will show, in a dry way, the number of beds, as now made public.

The coal-bearing rocks lie in very thin beds, alternating frequently, as the sections here given will show; and therefore they are not easily traced from place to place, especially in the new and mountainous districts, where mines are not much worked.

I first present the measured and estimated *dip* of the rocks, beginning at the Pennsylvania line on the North, and proceeding East and South into Virginia. These are taken from the Pennsylvania and Virginia Reports.

Valley of Allegheny River (Tarentum), S. S. West, 15 feet per mile.

Valley of Monongahela (Morgantown), nearly West.

Valley of Kenawha, seven miles below the Falls, North-West, 2° per mile.

This large dip on the Kenawha does not hold good throughout the valley, being subject to deductions for local counter dip. Below Charlestown, Virginia, it is reversed, and rises towards the North-west to the Western margin of the field, at the mouth of the Little Scioto, in Ohio.

From thence I have obtained frequent measurements, by levels made along lines from 1 to 10 miles in length, and in some cases 40 miles, which give precise results.

They are shown in the following table :

Dip of the Coal Rocks in Ohio, Commencing at the Ohio river and proceeding Northward.

Coal Grove	S. 57° East, 40 feet per mile.	
Scioto Furnace	S. 77° 30′ East, 101 feet per mile.	Variable.
" "	N. 62¾° East, 40 feet per mile.	
McConnellsville, Morgan Co., O.	South-east, 20 feet per mile (Hildreth).	
Zanesville	S. 87° East, 47.8 feet per mile.	
New Philadelphia	S. 86° East, 9.9 " " "	
Bolivar	S. 72° " 25.2 " " "	
Valley of Yellow Creek	S. 49¼° " 39.7 " " "	
" Sandy Creek, Sandyville to Rochester,	S. 43° " 36.1 " " "	
Massillon	S. 71° " 15.6 " " "	
Clinton	S. 23½° " 9.10 " " "	
Summit Co.	S. 53½° " 8.5 " " "	
Valley of Mahoning river	S. 12° " 20.6 " " "	

This brings us to the Pennsylvania line, from which we set out, having traversed the entire horizon.

On the Allegheny river, the plunge of the coal-beds is south of south-west. Farther south, from Laurel Hill to Morgantown, Pa., the strata dip westerly; and moving to the valley of the Kenawha the line of dip veers around to the north-west. Crossing the breadth of the field by passing down the Kenawha, and down the Ohio river to near Portsmouth, Ohio, the rocks incline with regularity to the south-east or east-south-east.

Thence following the position of the places in the above table, northerly and easterly, the change in the dip to the south is uniform, till we reach the line of departure, where it approaches the meridian.

The Virginia geologists divided the coal rocks into the "upper and lower coal group, and upper and lower sandstone group."

After much study and examination, I am unable to take up those divisions where they are left on the Ohio river, in Virginia, and carry them through Ohio, so as to bring them together again in Pennsylvania and Virginia, on the east. This may be owing to the want of *persistence* in the strata themselves. For instance: There is on the Muskingum river, near its mouth, a heavy, "non-fossiliferous" mass of limestone, which appears to be the same group of calcareous beds that overlie the great Wheeling coal seam. There is, below the Muskingum beds, a seam of coal, but by no means as heavy as that at Wheeling. The Wheeling and Pittsburgh main beds are regarded as the same stratum; and this is traced up the valley of the Monongahela to Brownsville.

Mr. Briggs, of the Virginia Survey, made a section of the rock below this bed at Morgantown, to the base of the coal rock; the conglomerate of Laurel Hill. By comparing it, as given below, with the sections of the coal rocks in Ohio, opposite Wheeling, and below the same bed, to the conglomerate of the Western Reserve, the thickness of the mass, the number of coal seams, and number of beds of limestone, is entirely different.

This can only arise from a lack of persistence in the strata. In Ohio, the next prominent group of limestone strata, below the Wheeling mass, as it appears on the Muskingum, is called by Dr. Hildreth, the "fossiliferous limestone." It crosses the Muskingum in Morgan Co., just above McConnellsville. This has been traced nearly to the Ohio river, in Meigs county, and is beneath the Pomeroy coal seam.

Farther north, in Carroll and Columbiana counties, and in Pennsylvania, it has not been noticed—not so much, perhaps, because it does not exist, as because it has dwindled down to a thickness not distinguishable from the ordinary limestone beds of the coal series.

In Ohio, the siliceous bed called Buhr stone, is very marked, and has been traced from the neighborhood of the river, in Gallia county, northerly into Tuscarawas. A "Buhr," or black flint bed, is described by Prof. Rogers, in his sections on the Allegheny river; and by Mr. Briggs, in his sections on the Kenawha. Probably this siliceous stratum, or its equivalent, will be found to encircle the whole coal field; but at the points where it is cut by our present sections, the number and character of the beds below it are by no means uniform.

Again, the sandstone mass, below the Pittsburgh seam, although it is recognizable where it crosses the Ohio, near Steubenville, and the Muskingum below McConnellsville, is not recognized above the Pomeroy coal seam, where it should be found if it maintained its separate existence and characters.

Every observation indicates a want of continuity in the coal bearing strata, the beds thinning out, and even disappearing, to be replaced by others, at different levels. This will be manifest, particularly in the coal beds themselves, as shown in the sections here given. They are placed in the same order as the statements of dip, but commence at the Ohio river, going northward and eastward into Pennsylvania, and thence southerly into Virginia, and to the Kenawha valley. They are limited mainly to the "lower coal group."

No. I.

Section of the rocks from the mouth of Little Scioto, South 60° East, to Symmes' Creek. Dip twenty feet per mile.

1.	Conglomerate, passing into sandstone. Its surface 90 feet above low water in the Ohio, and about the level of Lake Erie.	
2.	*Coal*	2 ft.
3.	Shale	6 "
4.	Coarse Grit	50 "
5.	Thin layers of *Iron Ore* and Coal	1½ "
6.	Coarse Grit	80 "
7.	*Limestone*—dark brown, with fossils	10 "
8.	*Iron Ore* ("Black Ore")	1 "
9.	Sandstone and Shales, embracing a thin seam of Coal and a bed of kidney ore	90 "
10.	Limestone—dark color, with fossils	7 "
11.	*Iron Ore*—calcareous, (thickness variable)	2 "
12.	Coarse Grit	40 "
13.	*Coal*, (thickness two to four feet)	3 "
14.	Grit, Shale and Pipe Clay	40 "
15.	*Coal*—six to twelve inches Shale in the middle; thickness variable	3½"
16.	Grit—embracing twelve ft. of Shale and kidneys of iron ore and a thin seam of coal	90 "
17.	*Iron Ore*—calcareous	1 "
18.	Grit and Shales, embracing two layers of iron ore; also, twenty inches of coal at level of high water on Ohio river, at Symmes' Creek, 8 miles from mouth	120 "
		547 ft.

This appears to be near the base of the "lower Sandstone group," as defined on the opposite bank of the Ohio river, in Virginia, by Mr. Briggs.

No. II.

Section of the Coal Rocks on the National Road, and Muskingum River.—From the Ohio Reports.

		Feet.	
1.	Conglomerate, surface at Brownsville, Ohio, two hundred feet above Lake Erie.		
2.	Sandstone and Shale	50	
3.	*Coal*—thickness variable	3	
4.	*Limestone*	2	
5.	Sandstone and Shale	130	
6.	*Limestone*	3	
7.	Sandstone	70	
8.	*Iron Ore*, thin	} 5	263
9.	Buhr stone, 2 to 6 feet		
10.	Grit	20	
11.	Shale	15	
12.	*Coal*	2	
13.	Sandstone—argillaceous	15	
14.	*Coal*	2	
15.	Shale	10	
16.	Grit, (Island Run, Muskingum River)	25	
17.	Shale	30	
18.	Limestone, with fossils	8	
19.	Black Shale	3	
20.	Coal (Pomeroy, bed of Ohio R),	5	398
21.	Iron Ore	2	
22.	Coarse Grit	50	
23.	Shales, red and calcareous	50	
24.	Shales, blue	8	
25.	Limestone	6	

26.	Shale, compact	3
27.	*Coal*—McConnellsville, 250 feet above Muskingum river; probably the Wheeling coal seam	4–521
28.	Bituminous shale	18
29.	Lime rock—several members	40
30.	Calcareous shales, and micaceous Sandstone	20
31.	*Coal*	1½ 600
32.	Coarse grit, with carbonaceous matter and pebbles	60
33.	Sand rock, argillaceous	20
34.	Sandstone, fine grained	25
35.	Shale, ocherous	4
36.	Sandstone, micaceous	40
37.	Shale. red	8
38.	Sandstone, slaty—mouth of Muskingum river and level of Lake Erie	80–037

The upper termination of my first section at Symmes Creek is several hundred feet below the Pomeroy coal bed, which Dr. Hildreth traced to the Muskingum river, as No. 20 of this section.

At Pomeroy there is a bed of coal 123 feet above that seam, which Dr. H. traced across the Muskingum, into Monroe county, and which is No. 31 of the above column, 99 feet above the Pomeroy.

The Virginia Geologists found in the coal series two barren spaces of several hundred feet in thickness, destitute of coal seams, and composed principally of sandstone. These barren grounds constitute their upper and lower "Sandstone groups."

Between Steubenville and Wheeling lies the "lower Sandstone group;" in that direction and on the lower side of the coal field, it comes to the Ohio between Big Sandy river and Pomeroy.

The strike of the strata, if we have it correctly, would carry this group below the Pomeroy bed. If we examine the section just given, measured by Dr. Hildreth and Mr. Foster, in the valley of the Muskingum, we find no prominent sandstone masses below the Pomeroy bed, on that river, nor between that and the McConnellsville seam. At Wheeling the great coal seam is *above* the "lower sandstone group," and is overlaid by heavy beds of limestone; and just above the McConnellsville coal seam, we find, in Nos. 29 and 30, similar beds on the Muskingum. On these is a thin bed of coal. The coal of this space is meager, while at Wheeling it is very strong.

From this thin bed (No. 31), we have a space of 233 feet in the upward section, extending to the Ohio river, and perhaps further, of *barren ground*, without limestone, iron ore or coal, and composed principally of sandstones. Is this the "upper sandstone group"? Where is the lower sandstone group? At Pittsburgh and Wheeling it is over three hundred feet thick. On the Muskingum the thickest bed is 50 feet. As there is no where else in the section, a body of limestone at all resembling the Wheeling beds, above the main coal seam, except the bed next above the McConnellsville coal seam, we are almost compelled to call that the Wheeling seam.

On this supposition, the lower sandstone group has diminished in thickness more than two-thirds in the distance of 60 miles, from Wheeling to the Muskingum. Moreover, there is not in any part of the last section, a thickness of barren ground large enough to strike the attention, or such as to lead an explorer to found a sub-division, till we ascend *above* the great calcareous mass.

At Wheeling the calcareous beds are several hundred feet above the "lower sandstone group," and at Pomeroy this group is below the main coal seam. Can there be an arrangement into groups that will answer for the whole coal field?

No. III.

Section of the Coal Rocks from the Conglomerate, in Summit county, Ohio, along the Ohio Canal, the Sandy and Beaver Canal, the C. & P. Railroad, and the Ohio river, to Wheeling, Virginia.

		Feet.
1.	Conglomerate, Clinton, Ohio. Surface 400 feet above Lake Erie.	
2.	Bluish Shales and flaggy Sandstones	60
3.	Coal, near Massillon, Ohio	4
4.	Grits and Shales alternating	150
5.	Blue Limestone, Bolivar and Zoar	3
6.	Shale, brownish color. [At Sheply's, three miles north of Bolivar, is a bed of coal in this shale, 3 feet thick, 37 feet above the limestone; 2½ miles south of Bolivar it is 58 feet above]	50
7.	Grit	40
8.	Brown Shale, embracing two thin beds of coal	100
9.	Coarse Grit	50
10.	*Coal*	4
11.	Limestone	3
12.	Brown Shale	30
13.	*Coal*, Waynesburg, 386 feet above L. Erie	3
14.	Grits and Shales, with thin and broken coal seams	120
15.	Coal, Rochester, 523 feet above Lake Erie	5
16.	Limestone, Hanoverton, and Salineville	3
	[There is difficulty in recognizing this bed beyond the Yellow Creek Summit, at Salineville, owing to a rise in	

the strata on the line of dip, for a short distance, in the direction of the Deep Cut. I assume the calcareous bed at the 79th mile post of the C. & P. Rail Road, to be the same as that at the 85th mile, or very near it. At Salineville, the lowest visible bed of coal is 300 feet above Lake Erie. The bed, with its accompanying limestone, that appears to be the same as that between Rochester and Hanover station, is, at Rochester, 523 feet above Lake Erie. Between Hanover station and Salineville, there is much irregularity and change in the thickness, the plunge, and the composition of the beds, that requires further examination.]

17.	Slaty Sandstone and brown Shale	60
18.	Coal	3
19.	Sandstone and Shale, with limited beds of Limestone and Coal	70
20.	*Coal*, "creek vein," Jockman's	3
21.	Sandstone and Shale	28
22.	Coal	2
23.	Sandstone and Shale	53
24.	Coal, "Rodgers' vein"	3
25.	Black Shale	16
26.	Brown "	40
27.	Black Shale, with kidneys of Iron ore	14
28.	Brown Shale and slaty Sandstone	27
29.	Shales and Sandstone	32
30.	Water lime bed	1½
31.	Shale and Sandstone	32
32.	Coal, "Big vein," same as Nisey's bed near mouth of Yellow Creek	6
	[Assuming this bed of coal to be the same as No. 11 of the section made by Mr. Briggs, on the Virginia shore of the river, opposite Yellow Creek, I continue the section to the base of the "lower Sandstone group," as given by that gentleman in the Virginia Report of 1841.]	
33.	Shale	5
34.	Sandstone, micaceous	30
35.	Shales	15
36.	Coal	4
37.	Grit and Shale	40
38.	Coal	2
39.	Grit and Shales, hills 8 miles above Steubenville	50
		1040

At Jockman's, 350 feet above the "big vein," and, at the summit of the hills, 606 feet above Lake Erie, is a bed of limestone 10 feet thick, that is not identified on the Ohio river, so frequent are the changes in the composition of the beds.

It would be interesting to add more of this section, and extend it to the great seam of coal at Wheeling; but this article has already become lengthy, and I proceed to give sections of the "Lower Coal Series" in Pennsylvania:

No. IV.

Section of the Coal Rocks in the Valley of the Allegheny river.—Geol. Rep. Pa., 1840.

		Feet.
1.	Conglomerate or white Sandstone, at the mouth of Clarion river.	
2.	Shale, with thin ore and coal	12½
3.	Coal	1½
4.	Sandstone and Shale	40
5.	Coal	4
6.	Shale	20
7.	Limestone, mouth of Kiskeminitas	15
8.	*Buhr stone* and Iron ore	3
9.	Shale	25
10.	" and Coal	11
11.	Grit	70
12.	Coal	2½
13.	Sandstone and Shale, Freeport	50
14.	Limestone	6
15.	Coal—140 ft above river at Freeport	4
16.	Shale	50
17.	Sandstone and Shale	75
18.	Coal	1
19.	Shale, very thin	
20.	Argillaceous Sandstone, level of low water at Pittsburgh, 140 feet above Lake Erie	30
21.	Shale, red and blue	30
22.	Coal, to base of "Lower Sandstone group"	1½
		450

No. V.

Section of Coal Rocks from Laurel Hill west to the Monongahela river. By Mr. C. Briggs, Geol. Rep. Va., 1841.

		Feet.
1.	Conglomerate	
2.	Shale	10
3.	Sandstone	4
4.	Shale and Iron ore, very thin	
5.	Sandstone	30
6.	Shale	18
7.	Coal	2½
8.	Flaggy Sandstone and Shale	30
9.	Coal	1
10.	Flaggy Sandstone and Shale	40
11.	Limestone	4
12.	Shale	10
13.	Sandstone	5
14.	Shale	6
15.	Coal	1½
16.	Shale	12
97.	Coal	3½
98.	Shale	35
69.	Coal	5

20. Sandstone, Morgantown, base of "lower Sandstone group" 60

277

Passing southerly along the eastern margin of the field, from the waters of the Monongahela to those of the Kenawha river, we present another section, taken from the Virginia Reports.

This is made down the valley of the Kenawha, nearly opposite the one first given, and dipping in a contrary direction.

No. VI.

Section of Coal Rocks on the Kenawha river, in Virginia.—Geol. Rep., 1840.

		Feet.
1.	Conglomerate	
2.	Micaceous Sandstone, slaty	
3.	Gray Shales	
4.	Limestone, 2 ft. 8 inches	
5.	Yellow Shales, ...in all	100
6.	Coal	3
7.	Micaceous Yellow Sandstone	
8.	Yellow Shales	
9.	Fire Clay ....in all	30
10.	Coal, "Huddlestone Seam," with 3 bands of Shale	7
11.	Bluish drab Shale, with madrepores in septaria or nadules, (*Vineyard Hill*)	40
12.	Coal, 1 foot 8 inches	2
13.	Argillaceous Sandstone	200
14.	Coal	3½
15.	Sandstone—surface at River level, Charleston, Va	215
16.	Coal	4
17.	*Hornstone*, blue and black (Buhr?).	7
18.	Iron ore	0½
19.	Grit, coarse yellow	140
20.	Red and yellow shales	
		752

In section No. 1, of this article, the counterpart of this, the Buhr or Hornstone bed was not noticed; and the same for section No. 3, along the Sandy and Beaver Canal; but there, fragments of it were seen in the gravel. Neither is the Buhr mentioned in the Monongahela section.

The last section includes both the lower coal groups, and the "lower sandstone groups" of the Virginia Reports, which do not appear to be here separated by a natural division. The "Hornstone" bed is near the top of the section, 470 feet from the conglomerate; on the National Road, 260, and on the Allegheny, 103 feet Is this everywhere the same bed, encircling the field? In every case it is associated with iron ore, in contact and always above it.

If the divisions into groups can be admitted, we discover the greatest disproportion in their thickness, as well as the number of beds that possess economical value, such as iron ore, coal and limestone.

The first section, certainly all of it below the lower sandstone group, is 447 feet in thickness. On No. 2, at the National Road, to the Pomeroy coal seam, which is several hundred feet above the Symmes' creek beds, is 478 feet. On No. 3, from Clinton to Yellow Creek, the thickness is 1159 feet, all in the lower group, while in the Allegheny valley it is reduced to 450, and in the Monongahela to 274.

I give, also, a recapitulation of the number of coal and limestone beds, in the various parts of the field, which will be seen to be quite different:

Number of Sections.	No. of Coal Seams.	Beds of Limestone.	Iron ore strata not all noted.	Thickness in feet.
1	6	2	8	547
2	8	5	5	
3	11	5	-	1041
4	7	2	-	452
5	4	1	2	277
6	5	1	1	

Such is a representation generally of the lower portion of the Allegheny coal field in its northern half. The depths to which shafts must be sunk any where in Ohio to cut all the beds, is not great—by no means equal to the depth of coal mines in Great Britain.

In the district of Tyne and Ware, South Staffordshire, the deepest pit is 598 yards, or 1794 feet.

At the mouth of Yellow Creek, a shaft less than 1000 feet would pass all the subordinate beds that crop out in Ohio.

The English coal fields, in different parts, present the same irregularity in the thickness and in the number of beds as our own.

A section of the Manchester coal basin in one part shows eighty-five (85) seams, more than a foot in thickness—in another only thirty-six (36).

The entire thickness of the Allegheny coal series is not yet well determined, nor the entire number of beds. It is to be hoped that the Legislatures of the four States that possess such vast riches in coal, as Ohio, Kentucky, Virginia and Pennsylvania, will eventually feel the necessity of having more detailed examinations made in concert throughout this field.

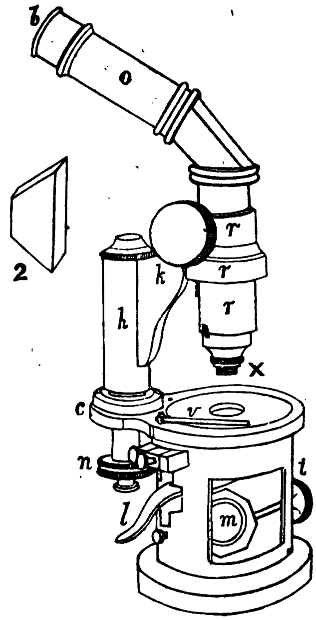
THE MICROSCOPE AND MICROSCOPIC MANIPULATIONS.

BY H. L. SMITH.

NO. III.

Nachet's Microscope.—This instrument, to be described presently, in its enlarged and complete form, may be considered as almost the *ne plus ultra* of compound microscopes. It has some defects, but they are, in my opinion, counterbalanced by its general excellence. For example, the field of view is not as large as in some of the more costly English and American microscopes, but what is the use of a large field indistinct at the border? There is no stage movement, except a little spring concern which serves for centering a crystal, for example, in measuring angles; this is a more serious disadvantage, when one has been accustomed to the beautiful movements of the lever or the Turrill Stage. An expert microscopist, however, prefers the use of the fingers, and when the object slider is held by the spring clips no great difficulty will be found in adjusting the object with sufficient delicacy. For the illumination of opake objects no other microscope is so convenient, and when the oblique prism, which bends forward the upper half of the body, is employed, it has all the advantage of the inclination obtained in other instruments which are mounted on trunnions, or pillars, to be used at any angle, with this capital advantage, that in the Nachet the stage is still horizontal, and fluids can therefore be placed under the objective, a trough, for instance, containing bits of chara or fucus, which cannot be done with the trunnion or pillar instruments of English or American construction. However, the advantages and disadvantages will be better appreciated from the description.

The following outline represents the Nachet Microscope. The general form of the stand is due to M. G. Oberhauser; it has, however, been essentially modified and improved by Nachet. The base consists of a brass cup, completely filled with lead, and lined with leather at the bottom, so that it can be moved on a table without fear of scratching. This base is almost $4\frac{1}{4}$ inches in diameter and $\frac{1}{2}$ inch high. A brass cylinder, 3 inches high, surmounts the base, and has in it a rectangular opening 2 inches by $1\frac{3}{4}$; the object of this cylinder is to support the stage and the illuminating apparatus. The concave mirror shown at *m* is not over $1\frac{1}{4}$ inches in diameter, but is of short focus, and gives an illumination quite as brilliant as the large mirrors of other instruments. On the opposite side it is plane; the movements are effected by the milled head, *i*. The stage plate surmounts the cylinder, and is circular, $3\frac{3}{4}$ in. diameter, inlaid with black glass, so that acids, &c., may be used without fear of injury; it has a projection shown at *c*, for the purpose of receiving the pillar which supports the body of the instrument;



Nachet's Microscope.

two spring clips, one of which is shown at *v*, and which are adjustable to suit different thicknesses of glass serve to hold the object firm upon the face of the stage; these may be entirely removed, if necessary. The whole stage has a very smooth circular motion around the top of the cylinder, and as the body of the microscope is revolved by the same movement, the object is not in the least displaced, but is presented in a different manner to the illumination. This movement is particularly convenient when the prism for oblique illumination is employed. The stage has a circular opening in the center, about $\frac{3}{4}$ of an inch diameter; underneath this opening a small tube is moved up and down by means of the lever *l;* in the smaller instrument this lever is attached at one end to the brass cylinder, consequently the diaphragms, polarizing apparatus, oblique prism, achromatic condenser, &c., which are fitted to the sliding tube, cannot be put under the object without moving it. In the large instrument we are describing, it is attached to a sliding plate, which may be drawn out, one side, and the various contrivances placed in the tube as may be required, and then slipped back under the object, without having disturbed it in the least. To the projection, *c*, of the stage, is firmly secured an upright pillar, about $\frac{3}{4}$ inch diameter and 3 inches high, over which slips a stout tube, *h*, a little more than three inches in length, having a horizontal projecting piece, *k*, terminated by a large ring, *r*, about 2 inches diameter, into this ring screws a vertical tube, *r*

r, 1¼ inches diameter inside, through which the body of the microscope slides smoothly. The body of the microscope is 8 inches in length, and about 1¼ inches diameter; it consists of two parts; the upper part, *o*, receiving the eye-pieces, *b*, may be unscrewed, and between this and the lower part, the prism, shown separately in fig. 2, may be placed, giving the instrument all the advantages of an inclined tube. When the prism is employed, and which does not affect the definition of the most delicate objects, the upper half of the body may be moved completely round without disturbing, in the least, the focal adjustment for the slit tube of the prism slips freely into the lower half of the main body, and thus when one has adjusted the object, it may be successively viewed by a number of persons around a small table without changing seats, by revolving the inclined part of the tube, an advantage of signal importance in class demonstrations. To the lower part of the main tube, the object-glasses are attached in the usual manner, being three achromatics combined, as will be explained in another article.

The quick motion for focal adjustment is obtained by sliding the lower half of the main tube through the slit tube, *r r*, and the fine adjustment is very beautifully and steadily effected by means of the milled head, *n*, which moves the tube *h*, the return movement being effected by a strong spiral spring.

The accessories furnished with this instrument vary, being usually a stage micrometer, 1 millmetre divided into 100 parts, an eye-piece-micrometer, a set of diaphragms for modifying the light, an achromatic condensor, a prism for oblique illumination, camera lucida, polarizing apparatus, trough, condensor for opake objects, 3 eye-pieces and 4 objectives, Nos. 0, 2, 4 and 6, prism for bending the tube, two dissecting points, and a scalpel—costing, in all, say $125. By unscrewing the brass adapter at *x*, which receives the higher objectives, those of a lower power and larger diameter may be attached.

With this instrument objectives may be used varying from 2½ inches to $\frac{1}{16}$, with the greatest facility. The stand is remarkably steady, and being but 4 inches in height above the table, one may rest the arms and manipulate with the greatest ease. The whole instrument packs neatly away in a box about 12 inches long, 8 in. wide and 5 in. deep.

A long use of this instrument, and comparison with other forms, obliges me to give it a decided preference. It is less showy, but this is of no importance. Solidity and stability are the points attained, combined with simplicity and convenience. The Nachet instrument is sold by McAllister & Co., Philadelphia, and, doubtless, may be obtained of the New York Opticians. Mr. John Roach, Nassau st., N. Y., has the Oberhauser, of cheaper make, but in the main as I have described, with excellent objectives, for from $30 to $45. Messrs. Emmerich & Gr. Vila, John st., N. Y., sell an instrument such as I have described, having the accessories, except the prism for bending the tube, the sliding apparatus for changing the diaphragms, &c., under the stage without disturbing the object, the prism for oblique illumination, and but three objectives, for $75 to $80, and a smaller one for $45 to $50. These instruments are not made by Nachet, but the workmanship is very good, perhaps equal to his, and the objectives nearly or quite as good.

ON THE MOTION OF ELASTIC FLUIDS AND THE THEORY OF WIND INSTRUMENTS.

BY A. MASSON.

The author's memoir treats of the flow of elastic fluids through circular orifices pierced in metallic plates; the acoustic phenomena produced by the flow of air through circular orifices adapted to cylindrical pipes; numerous experiments on pipes of different material and length; an examination of the various theories proposed as explanatory of the motion of air in acoustic pipes, together with some remarks on the function of the apertures of organ pipes.

Flow of air through circular orifices.—A rectangular deal box was suitably placed upon the reservoir of an organ bellows, and on its upper surface were adjusted metal disks pierced at their centers with a circular orifice. A manometer—consisting of a narrow inclined tube communicating at one part with the conduit pipe and at the other with a large flask with water—indicated the pressure during the experiment. This differential manometer, capable of being inclined in any direction, gives the true pressure by multiplying the variations of the column of water by the sine of the respective incinations. Several applications of this new apparatus are pointed out in the memoir; its great sensibility was a main condition of the success of the experiments, which required the application of very minute degrees of pressure, frequently less than that of one millimetre of water.

The air in flowing through the circular orifices in the metallic plate produces a sound which rises to a higher pitch in a continuous manner with the increase of pressure, as in the syren.

The sounds which can be obtained from the same orifice are comprised within two limited pressures, which depend upon its diameter and the thickness of the plate.

Elastic fluids in passing through narrow apertures acquire a vibratory condition; the number of vibrations which they perform in any case is proportional to the square root of the pressure

or to the velocity of their flow, and is not dependent upon the diameter of the orifices.

Flow of air through orifices surmounted by acoustic pipes.---The periodical motion of the air which flows through the orifices does not always exercise upon the organ of hearing an action sufficiently energetic to give rise to the sensation of sound.

The stoppage of the vibrations by the mass of exterior air, the form, still unknown, of the gaseous vein, the too feeble elasticity of the fluid, may contribute, together or separately, to the prevention of any acoustic impression.

In order to strengthen the sounds originally produced at the orifice from which the flow takes place, for the purpose of submitting to a further investigation the laws of the vibrations of columns of air, a cylindrical pipe of wood was fixed upon the metallic plate, so that its axis passed through the center of the acoustic aperture.

When air was forced through by the bellows a sound was produced, and the vibrations were communicated to the pipe, which gave out a series of harmonics comparable in point of purity and intensity to the finest sounds of the organ.

The results of these experiments upon the motion of air in tubes may be expressed as follows:

1. The air flowing from an orifice acquires a vibratory condition capable of producing sound in gaseous columns.

2. The acoustic phenomena are not altered by placing the orifice on the upper or under part of the pipe through which the air flows, or by forcing or drawing the air through it.

3. The sounds which any one pipe is capable of giving depend only on the pressure of the air and not on the diameter of the orifices. The number of vibrations appear to be, for a constant aerial pressure, proportional to the thickness of the plates.

4. The different harmonies of a pipe vibrated by air issuing through a circular orifice may be thus classified:

a. Several sounds deeper than the fundamental sounds of the pipe.

b. Sounds of the open pipe, agreeing with theory.

c. Sounds of the closed pipe, agreeing with theory.

d. Indeterminate sounds.

e. Harmonic sounds of the theoretic wave.

5. The space comprised between two ventral segments or two nodes of vibration is always conformable to theory, with the exception of a portion of the pipe near the plate.

Terminated by two ventral segments, or by one ventral segment and one node, this portion is generally much smaller than an actual wave.

6. The acoustic wave, situated at the extremity of the pipe, which is the seat of the initial vibratory motion, and the real or theoretic wave at a distance from this, always vibrate in unison, and their lengths bear a simple and harmonic ratio to each other.

7. For the same orifice in the same pipe a sound may be produced by very different pressures, but they still preserve a harmonic proportion to each other.

8. For any one sound the pressure varies within certain limits, without the tone of the pipe manifesting the slightest alteration; it is only the intensity of the sounds which increases or decreases with the pressure.

9. One pipe may give several sounds simultaneously.

10. To a given mouth-piece, a pipe possessing the property of rendering a sound distinct always corresponds, notwithstanding the variations of atmospheric pressure.*

Every possible means have been adopted for verifying the consequences of the principal facts which have been announced above, and the greatest care and attention must be paid to the determination of the ventral segments of vibration. It was by piercing or cutting the pipe that the author has succeeded in determining the points at which the air retains its natural state throughout the entire time of vibration. He has thus ascertained that the two open extremities of the pipe are always ventral segments, and that the part near the mouthpiece may be comprised between two or between one node and one ventral segment. It is possible without altering the sound to remove the whole of that portion of the tube situated above the extreme wave.

In the series of sounds represented by the formula which characterizes closed pipes, the half-wave near the acoustic orifice is always comprised within two ventral segments; this circumstance sufficiently distinguishes this series from those of Bernoulli.

In addition to the remarkable fact, that a column of air comprised within two ventral segments, without interposition of a node, gives a deeper sound than the fundamental sound determined by its length, the athor states that the exceptional wave may sound under two very different pressures; the greatest is necessary to produce the sound when the pipe is restored to its original length.

In all the experiments the volume of the reservoir of air or the conduit pipe was changed several times without any recognizable alteration in the phenomena being produced.

All pipes, whatever their dimensions of material, conform to the same laws. Pipes of

*The practical value of these principles has already been shown in a work published by M. Louyet and the author, upon the theory of wind instruments and of the voice (Traite de Physiologie, par F. A. Louyet, tome 1, fasicule 3).

wood, gutta percha, glass, and metal, were employed; the ratio of the length and diameter has varied from 4 to 40, and no exceptions to the principles laid down by the author were met with.

By placing the acoustic orifice between two tubes of the same diameter and length which bear a simple proportion to each other, it was found that the two columns vibrated in unison, when by their division they were capable of giving rise to subdivisions of the same length, the exceptional parts situated at each side of the plate being equal to each other, or to an octave. In every other case the note of one pipe alone is heard.—*Comptes Rendus*, Feb. 1853.

ON THE THEORY OF WATER SPOUTS, CYCLONES, &C.

BY THOMAS DOBSON, B. A.

Our knowledge of cyclones is limited to that mature condition of the phenomenon in which it has become a hurricane; nothing is known of their origin, and very little of their gradual development. It might be anticipated that some light would be thrown on these important points by investigating and comparing the corresponding phases of the apparently analagous phenomena of waterspouts, tornados, &c. This comparison seems to have been somewhat too hastily abandoned by cyclonologists on meeting with some cases in which the law of rotation *appeared* to be violated. If this descrepancy had been well established, it might be thought fatal to the hypothesis of the homogeneity of the two meteors; but the observations of the the direction of waterspouts are both too few and too uncertain to outweigh the numerous remarkable coincidences which tend to show that *cyclones and waterspouts differ only in degree;* a waterspout being either a cyclone in miniature, or an embryo cyclone. In several instances two or three waterspouts have been seen within the area of one cyclone, which confirms the supposition that both meteors are produced by the same physical agent. Each has a motion of rotation about a vertical axis, and another of translation along the surface of the earth. Both arise after extreme heat, and travel towards a colder region. The central portions of both are characterized by an excessively low temperature and extreme rarefaction; by copious falls of rain, snow, and hail; by peculiar noises; by lightning, and other manifestations of the presence of electricity. Further research will disclose more points of close resemblance. An inquiry into the origin and nature of waterspouts, tornados, and other apparently cognate phenomena, may, therefore, lead to valuable suggestions respecting the more important, but less known phenomenon, called a cyclone.

The following appear to be the main facts which are available as a basis for a theory which shall comprehend all the meteors in question:

I. *The eruption of a submarine volcano has produced waterspouts.*

"During these bursts the most vivid flashes of lightning continually issued from the densest part of the volcano, and the columns of smoke rolled off in large masses of fleecy clouds, gradually expanding themselves before the wind in a direction nearly horizontal, and drawing up *a quantity of waterspouts.*"—*Capt. Tilland's description of the upheaval of Sabrina Island in June* 1811, *Phil. Trans.*

With this significant fact may be compared the following analogous ones:

"In the Aleutian Archipelago a new island was formed in 1795. It was first observed *after a storm*, at a point in the sea from which a column of smoke had been seen to rise."—*Lyell, Principles of Geology.*

"Among the Aleutian Islands a new volcanic island appeared in the midst of *a storm*, attended with flames and smoke. After the sea was calm, a boat was sent from Unalaska, with 20 Russian hunters, who landed on this island on June 1, 1814."—*Journal of Science*, vol. vii.

"On July 24, 1818, a submarine eruption broke out between the mainland of Orkney and the island of Stronsa. Amid thunder and lightning a very dense jet-back cloud was seen to rise from the sea, at a distance of five or six miles, which traveled towards the north-east. On passing over Stronsa, the wind, from a slight air, became *a hurricane*, and a thick, well-defined belt of large hailstones was left on the island The barometer fell two inches."—*Trans. Royal Soc. Edinb.* vol. ix.

2. *Hurricanes, whirlwinds, and hailstorms, accompanying the paroxysms of volcanos.*

"1730. A great volcanic eruption at Lancerote Island, and *a storm*, which was equally new and terrifying to the inhabitants, as they had never known one in the country before."—*Lyell; Principles of Geology*, vol. ii.

"1754. In the Philippine Islands a terrible volcanic eruption destroyed the town of Taal and several villages. Darkness, hurricanes, thunder, lightning, and earthquakes alternated in frightful succession."—*Edinb. Phil. Journal.*

"In 1805, 1811, 1813 and 1830, during the eruptions of Etna, caravans in the desert of Africa perished by violent whirlwinds. In 1807, while Vesuvius was in eruption, a whirlwind destroyed a caravan."—*Rev. W. B. Clarke, in Tasm. Journal.*

"1815. Java. A tremendous eruption of the Tombow Mountain. Between 9 and 10 P. M. ashes began to fall, and soon after a *violent whirlwind* took up into the air the largest trees,

men, horses, cattle, &c."—*Raffles' History of Java.*

"1817. December. Vesusuvius in eruption. In the evening *a hailstorm* accompanied with red sand."—*Journal of Science,* vol. v.

"1820. Banda. A frightful volcanic eruption, and in the evening an earthquake and violent hurricane."—*Annales de Chimie.*

"1822, Oct. Eruption of Vesuvius. Towards its close the volcanic thnnder-storm produced an exceedingly violent and abundant fall of rain." *Humboldt, Aspects of Nature.*

"1843. Jan. Etna in eruption. Violent hurricanes at Genoa, in the Bay of Biscay, and in Great Britain.

"1843, Feb. Destructive earthquakes in the West Indies, a volcanic eruption at Guadaloupe, followed by hurricanes in the Atlantic.

"1846, June 26. Volcano of White Island, New Zealand, in eruption. Heavy squalls of wind and hail; it blew as hard as in a typhoon." —*Com. Hays, R. N., in Naut. Mag.*, 1837.

"1847, March 20. Volcanic eruption and earthquake in Java; and on the 21st of March and 3d of April violent hurricanes."—*Java Coruant.*

"1851, Aug. 5. A frightful eruption of the long dormant volcano of the Pelée Mountain, Martinique. Aug. 17, hurricane at St. Thomas's, &c.; earthquake at Jamaica, &c.

"1852, April 14. Earthquake at Hawaii, and on the 15th a great volcanic eruption. On the 18th *a gale of unusual violence* lasted 36 hours, and did great damage."—*The Polynesian, April* 22, 1852.

3. *In volcanic regions, earthquakes and hurricanes often occur almost simultaneously, but in no certain order, and without any volcanic eruption being observed.*

In 1712, 1722, 1815 and 1851, earthquakes and hurricanes occurred together in Jamaica. In 1762 at Carthagena; in 1780 at Barbadoes; in 1811 at Charleston; in 1847 at Tobago; in 1837 and 1848 at Antigua; in 1819 an awful storm at Montreal, rain of a dark inky color, and a slight earthquake. People conjectured that a volcano had broken out. In 1766 the great Martinique hurricane, a *waterspout* burst on Mount Pelée and overwhelmed the place. Same night, an earthquake.

1843, Oct. 30. Manilla. Twenty-four hours rain and two heavy earthquakes. 10 P. M. a severe hurricane.

"1852, Sept. 16. Manillo. An earthquake destroyed a great part of the city; many vessels wrecked by a great hurricane in the adjacent seas between the 18th and 26th of September."—*Singapore Times.*

"1737, Oct. Calcutta. Furious hurricane and violent earthquake; 300,000 lives lost.

"1618, May 26. Bombay. Hurricane and earthquakes, 2000 lives lost."—*Madras Lit. Trans.*, 1837.

"1800. Ongole, India, and in 1815 at Ceylon, a hurricane and earthquake shocks."—*Piddington.*

"1348. Cyprus. An earthquake and a frightful hurricane."—*Hecker.*

"1819. Bagdad. An earthquake and *a storm,* an event quite unprecedented.

"1820, Dec. Zante. Great earthquake and hurricane, with manifestations of a submarine eruption."—*Edinb. Phil. Jour.*

"1831, Dec. Navigators' Islands. Hurricane and earthquakes."—*Williams' Missionary Enterprize.*

"1848, Oct., Nov. New Zealand. Succession of earthquake shocks and several tempests.

"1836, Oct. At Valparaiso a destructive tempest and severe earthquakes."—*Naut. Mag.* 1848.

When an earthquake of excessive intensity occurs, as at Lisbon in 1755, the volcanic craters, which act as the safety-valves of the regions in which they are placed, are supposed to be sealed up; and it is a remarkable and highly suggestive fact, that *no hurricane follows such an earthquake.* The number of instances of the concurrence of ordinary earthquakes and hurricanes might be easily increased, but the preceding suffice to show the *generality* of this coincidence both as *to time* and place.

4. *The breaking of waterspouts on mountains sometimes accompanies hurricanes.*

In 1766, during the great Martinique hurricane, before cited.

"1826, Nov. At Teneriffe, enormous and most destructive waterspouts fell on the culminating tops of the mountains, and a furious cyclone raged around the island. The same occurred in 1812 and in 1837."—*Espy and Grey's Western Australia.*

"1829. Moray. Floods and earthquakes, preceded by waterspouts and a tremendous storm." *Sir T. D. Lauder.*

"1826, June. Hurricanes, accompanied by waterspouts and fall of avalanches in the White Mountains."—*Silliman's American Journal.*

5. *The fall of an avalanche sometimes produces a hurricane.*

"1819, Dec. A part (360,000,000 cubic feet) of the glacier fell from the Weisshorn (9000 feet). At the instant when the snow and ice struck the inferior mass of the glacier, the pastor of the village of Randa, the sacristan, and some other persons *observed a light.* A frightful hurricane immediately succeeded."—*Ed. Phil. Journal,* 1820.

6. *Waterspouts occur frequently near active volcanoes.*

This is well known with regard to the West Indies and the Mediterranean. The following notice refers to the Malay Archipelago and the Sandwich Islands:

"Waterspouts are *often* seen in the seas and straits adjacent to Singapore. In October, 1841, I saw *six* in action attached in one cloud. In Aug. 1838, one passed over the harbor and town of Singapore, dismasting one ship, sinking another, and carrying off the corner of a roof of a house in its passage landward."—*Journal of Indian Archipelago.*

"1809. An immense waterspout broke over the harbor of Honolulu. A few years before one broke on the north side of the island (Oahu), washed away a number of houses, and drowned several inhabitants."—*Jarves's History of the Sandwich Islands.*

7. *Cyclones begin in the immediate neighborhood of active volcanos.*

The Mauritius cyclones begin near Java; the West Indian near the volcanic series of the Caribbean Islands; those of the Bay of Bengal near the volcanic islands on its eastern shores; the typhoons of the China sea near the Philippine Islands, &c."

8. *Within the tropics, cyclones move towards the west; and in middle latitudes, cyclones and waterspouts move towards the north-east in the northern hemisphere, and towards the south-east in the southern hemisphere.*

9. *In the northern hemisphere cyclones rotate in a horizontal plane in the order N.W.S.E.; and in the southern hemisphere, in the order N.E.S.W.*

By applying the principles of electro-dynamics to the electricity of the atmosphere, I shall endeavor to connect and explain the following well-defined facts. The continuous observations of Quetelet on the electricity of the atmosphere from 1844 to 1849 (*Literary Journal*, February 1850), show that it is always positive, and increases as the temperature diminishes. It therefore increases rapidly with the height above the earth's surface. We may consequently regard the upper and colder regions of the atmosphere as an immense reservoir of electric fluid enveloping the earth, which is insulated by the intermediate spherical shell former by the lower and denser atmosphere. Now, whenever a vertical column of this atmosphere is suddenly displaced, the surrounding aqueous vapor will be immediately condensed and aggregated, and the cold rarefied air and moisture of the column will form a vertical conductor for the descent of the electric fluid. This descent will take place down a spiral, gyrating in the order N.W.S.E. in the northern hemisphere, since the electric current is under the same influence as that of the south pole of a magnet; and in the order N.E.S.W. in the southern hemisphere. The air exterior to the conducting cylinder will partake of the violent revolving motion, and a tornado or cyclone will be produced. The facts marked 9 are thus accounted for, as well as the numerous circumstances indicative of intense electrical action, such as the appearance of fiery meteors, the loss of sight, the deranged action of the needle, &c.

As long as the integrity of the conducting column is maintained and the supply of electric fluid continued, the aqueous vapor through which a cyclone passes will be condensed and accumulated. Hence arises the immense fall of water (always *fresh*) when a waterspout breaks, and the excessive rains that accompany the passage of the central space of a cyclone. When the condensation is sufficiently sudden and intense, hail and even ice may be formed. The fact marked 4 is thus explained.

A physical mechanism adequate to the formation of the conducting cylinder presents itself in the form of an avalanche (fact 5), and in the sudden ejection from a volcanic crater of long pent-up and highly elastic gases (facts 1, 2, 6 and 7). It follows, moreover, that a waterspout, a tornado, or even a cyclone, *may* be produced by anything which tends to form a vertical column of considerably less density, or of much greater humidity, than the surrounding atmosphere. Hence the well-known fact that storms follow great battles, great bush fires, &c.

When an earthquake and a cyclone occur nearly together in the neighborhood of a volcano, the earthquake indicates the activity of the volcanic forces, and the cyclone bears evidence of the sudden ejection of gases from the crater, although no eruption of flame or lava may have taken place or been observed (fact 3). The atmosphere will be most highly charged with electricity, and therefore the tendency to a violent restoration of electrical equilibrium will be most powerful just after the season of greatest heat, during which the processes of evaporation and vegetation have been most active, and therefore the development and accumulation of atmospheric electricity most rapid. Accordingly it is found that cyclones generally originate in tropical regions; that the hurricane season in any locality is the same as the season of greatest heat; and that waterspouts, tornados, and hailstorms, occur on very hot days. The terrestrial electric currents flow towards the magnetic west, and must therefore decline towards the south in passing from Java towards the Mauritius, and towards the north in passing from the Caribbean

Isles (Barbadoes; Martinique, &c.), towards Cuba. This explains the direction of the two great cyclone tracts in the South Indian Ocean and in the West Indies, up to the points where they are found to recurve, but the facts enunciated in 8 concerning the direction of a cyclone's track in middle latitudes remains unaccounted for. With this exception, the electro dynamical theory of cyclones here proposed will account for every important and definite fact connected with the phenomenon, and will likewise embrace the obviously allied phenomena of waterspouts, tornados, hail-storms, &c.

It follows from this theory, that hurricanes are most likely to be produced by such volcanic eruptions as succeed seasons of great heat, and that the eruption of a low volcano is more likely to produce a hurricane than that of a high one, since the whole of the insulating atmospheric shell is pierced through in the former case, and only the upper portion of it in the latter.—*London, Edinburgh and Dublin Phil. Magazine.*

THE CALIFORNIAN GULL—(*Laurus Californicus.*)

Bill rather slender, and much curved; wings extending a little beyond the end of the tail; legs and feet small; tail even.

Adult.—Bill yellow, upper mandible pale, except from the base, as far as, and on a line with, the nostrils, where it is of a dull green, just beyond the nostrils is a transverse blackish mark, which reaches nearly to the ridge, under mandible yellow, dusky on the sides, at the angle it is crossed by a black spot or bar, bordered with reddish orange; the mark on the upper mandible is opposite to this; head white, except the crown and occiput, which are light ash, the feathers of the hind parts and sides of the neck have their centers blackish ash; neck, entire under plumage, rump and tail white; mantle and wings pearl blue; the six outer primaries are crossed by a band of deep black, the first is almost entirely of this color, but it gradually becomes less to the sixth, on which it is reduced to a narrow subterminal bar; all the primaries are tipped with white, on the exterior one the white is about two inches in extent, and has a black bar dividing it near the tip, there is a small white spot on the outer web of the second, next the shaft, and about one inch and a half from the end; the secondaries terminate with white; legs and feet (in the dried specimen) dull greenish yellow; claws black.

Total length of skin, 23 inches; wing, from flexure, $15\frac{1}{4}$; tail, $6\frac{1}{2}$; bill, along the ridge from front base point, 2, from rictus to point of lower mandibille, $2\frac{3}{4}$; height of bill at the angle, $\frac{11}{16}$; bare space on tibia, $\frac{3}{4}$; tarsus, $2\frac{1}{8}$; middle toe and nail, $2\frac{1}{4}$; inner toe and nail, $1\frac{3}{4}$; hind toe and nail, $\frac{1}{2}$ inch.—*Habitat*—California.

The specimen described was presented to me by E. S. Holden. Esq, who shot it on the San Joachin River, near Stockton.

It belongs to the group of Gulls which includes *L. argentatus Linn.* and *L. occidentalis Aud.* The bill is weaker and more slender than either of these, that of *L. occidentalis* being relatively large, and having great depth at the angle, the tarsi and toes are comparatively much shorter than in either of the above allied species. The mantle is many shades darker than that of *L. argentatus*, but not so dark as that of *L. occidentalis* (which is slate blue), being about intermediate in color.

The dark feathers on the neck probably denote its winter plumage; in summer the entire head and neck is, no doubt, white.—*Ann. Lyc. Nat. Hist., N. Y.*

ELLIPTIC ELEMENTS OF THE PLANET EUTERPE, DISCOVERED BY MR. HIND, NOV. 8, 1853.

FROM THE CALCULATIONS OF M. CHARLES MATHIEU.

Epoch, 1853, Nov.	8.395103
Mean anomaly of epoch	332° 49′ 16″.99
Longitude of perihelion	86° 21′ 9″.77
Long. of ascending node	92° 38′ 54″.04
Inclination	1° 39′ 42″.32
Eccentricity (φ=9° 8′ 11″.9)	0.1587860
Semi-major axis log. a=0 3755699)	2.3695716
Mean motion (log. μ=2.9880017)	972″.7510
Sidereal revolution	3^{yrs}.647580

This orbit was calculated from the observations of Nov. 8th, at London, and 17th and 29th Nov., at Paris.

The position of the planet from an ephemeris, calculated with the above elements, for

January 31, 1854, was	A. R. 3^h 13^m 55^s
Declination North	17° 31′.2
Feb. 28th	A. R. 3^h 55^m 45^s
Declination North	20° 19′.1

Comptes Rendus, xxxvii, 960.

MODE OF OBTAINING CAMPHOR FROM OIL OF SASSAFRAS.

BY M. FALTIN.

M. Faltin found that during the action of chlorine gas upon the oil of sassafras, the latter becomes converted into a thick tough mass, whilst a large quantity of hydrochloric acid is formed. After neutralization with milk of lime, this mass furnishes on distillation a small quantity of camphor, which is perfectly identical in its properties and composition with common camphor. It could only be obtained from the oil by the action of chlorine. It is probably produced from the unoxygenated oil contained

in the oil of sassafras. This observation therefore possesses some interest, as the Sassafras tree belongs to the *Laurinœ*, the same family which includes the Japanese camphor-tree.

THE PHOTOGRAPHIC SOCIETY.

In whatever light this new association may be regarded, the least observant cannot fail to receive an impression calculated to make him ponder the peculiarity of the age in which he lives. The block-printing of another time, rough and rude as, in our own chair of learning, we may deem it, was, we must still reccollect, when first introduced, the wonder and admiration of man; while to the more learned and the deeper thinker, the admiration and wonder were greater. A new means of disseminating power of the mightiest kind—the influence of mind upon mind—was not a discovery of every day. It was once to be made in the world. It was made, and made forever. No doubt, all then regarded it as ultimate fact. There imagination was filled with its then present and immediate potency, rather than with its significance. But to him who was not lost in wonder, it could signify a great deal—a very great deal indeed—in all probability more even than we now can divine. For it was a principle, rather than a bare and barren fact, that came in with the new art, but which it was reserved for these days of typographic telegraphs and photographic societies to prove. There are more methods of printing than by blocks. Photography is, in every respect, one of them, and so much the more superior to all others, as it is the direct impress of nature partaking in a large measure of the beauty of the forms which the eternal world, in all its combinations, constantly furnishes forth. The natural delight experienced in beholding these forms, as naturally induces the imitation of them—the effort, more or less successful, to make enduring the perishable and fleeting. It is, consequently, no matter of surprise to find many of the more ardent lovers of these things, who, each in his way, has followed the impulse of his natural taste in the most skillful method known to him, associating together for mutual benefit. * * * * * *

The rapid progress of this society is one of the great facts of the day. The recent exhibition at the Gallery of the Society of Brittish Artists might almost have been called another kind of laboratory, where numerous experiments might, with more propriety, be said to be performing, then where their results were shown. The different degrees of beauty of the many different processes employed in the production of the example were readily observable, while different conditions in the same process were equally remarkable. This is a beginning only. By-and-by we shall have better things still, because we know that all were not good. We hope also that some one of the members of this new society will feel it not beneath his dignity to generalize somewhat the many processes now being employed in the new art. * * * Surely, by this time, some of these processes ought to have been found to be better than others, or more adapted to particular purposes. But there was nothing in the exhibition to show this. We tried to make the discovery, but failed. It ought to have been done for the general public, before any such display was ventured upon. It is solely attributable to this that the thing has passed off so flat, after the first exhibition of photography, at the rooms of the Society of Arts during the last year. Other causes contributed, no doubt; but as far as the public are concerned, they who did not visit the gallery in Suffolk Street lost much. They would have seen many things to interest them. It is something to have visited the natural scenery described by a master-hand, before we read his description of it. He may enable us to *comprehend* what we merely *saw.* It would be more to have stood with him on the very spot, and seen, as it were, with his eyes the diversified forms and tints before him. But here the objects had very obligingly printed themselves for our observation without the necessity of any personal visit. Rome and Venice stood before us in their marbles (though statue like) as wondrously as did the mountains of Switzerland and the snow storm. *Wonderful* is the true term to give to these pictures; and what they are the first fruits of, will be more wonderful still. Copies from crayon drawings and copies of engravings and of lithographic prints; most admirable natural history specimens, lizards for instance: the application of photography to the microseope, by sun-light and artificial light; articles of vertu; breaking waves on the sea shore; portraits of the insane; animals from those in the zoological gardens; the solar spectrum; copies of the phenomena of polarized light in crystals; specimens of engraving on steel plates by the influence of sunshine on a preparation of chromium, and subsequent etching by chloride of platinum (Mr. Talbot's invention); natural impressions of clouds, &c. All these objects are excessively interesting, and sufficiently demonstrate the turn which this new art is taking, and show the territories it is invading. We shall hope that, by the time the next exhibition takes place, something more definite will be capable of being communicated, by means of which the pleasure derived from it will not be limited to the personal visitor, but accessible to the photographer, however distant his residence, and however humble his means. For it is prëeminently a popular art. All may become adepts in it.—*Practical Mechanic's Jour.*

☞ PLEASE READ. ☜

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CONTENTS OF NO. V.